Sampling and Analysis Plan/ Quality Assurance Project Plan

Evaluation of Dredged Material Proposed for Ocean Disposal, Military Ocean Terminal Sunny Point, North Carolina (MOTSU)

Submitted to:

U.S. Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403

Submitted by:

ANAMAR Environmental Consulting, Inc.
2106 NW 67th Place, Suite 5
Gainesville, FL 32653
(352) 377-5770

ANAMAR
Environmental Consulting, Inc.

(ANAMAR Project No. 17-0003)

April 2017

GROUP A. PROJECT MANAGEMENT

1.0 ELEMENT A1 – TITLE AND APPROVAL SHEET

Organization/Applicant: U.S. Army Corps of Engineers-Wilmington District

Technical Manager: Justin Bashaw

Signature: _____ Date: 25Apr2017

QA Manager: Justin Bashaw

Signature: _____ Date: 25Apr2017

Regulatory Agency: EPA Region 4
Project Manager: Gary Collins

Signature: _____ Date: 04/27/2017

QA Manager or Designated Approving Official:

Print name: _____

Signature: _____ Date: _____

Contractor 1: ANAMAR
Project Manager: Terence Cake

Signature: _____ Date: 27-Apr-2017

QA Officer: Paul Berman

Signature: _____ Date: 4/27/17

2.0 ELEMENT A2 - TABLE OF CONTENTS AND ACRONYMS

Attachments

Figures

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ACRONYMS AND ABBREVIATIONS

ASPRS	American Society for Photogrammetry and Remote Sensing
CCB	continuing calibration blank
CCV	continuing calibration verification
CFR	Code of Federal Regulations
CMC	criterion maximum concentration
COC	contaminant(s) of concern
CQAR	Chemical Quality Assurance Report
cy	cubic yards
DQCR	daily quality control report
DU	dredging unit
EPA, USEPA	U.S. Environmental Protection Agency
ERL	effects range low
FDA, USFDA	U.S. Food and Drug Administration
ICB	initial calibration blank
ICV	initial calibration verification
ITM	Inland Testing Manual (EPA and USACE 1998)
LCS/LFB	laboratory control sample/laboratory fortified blank
LPC	limiting permissible concentration
LRL	laboratory reporting limit
MB	method blank
MDL	method detection limit
MLLW	mean lower low water
MOTSU	Military Ocean Terminal at Sunny Point
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NCSPA	North Carolina State Ports Authority
NELAC	National Environmental Laboratory Association Conference
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
ODMDS	ocean dredged material disposal site
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
QA/QC	quality assurance/quality control
QAM	quality assurance manual
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SDS	Spatial Data Standards
SERIM	Southeast Regional Implementation Manual (EPA and USACE 2008)
SOP	standard operating procedure
SPP	suspended particulate phase
SRM	standard reference material
TBD	to be determined
TDL	target detection limit
TEL	threshold effects level
TOC	total organic carbon
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

3.0 ELEMENT A3 - DISTRIBUTION LIST

This document is to be distributed to the following individuals for review and approval prior to commencement of sampling activities:

1. U.S. Army Corps of Engineers (USACE) Technical Manager: Justin Bashaw
2. USACE Quality Assurance/Quality Control (QA/QC) Manager: Justin Bashaw
3. USACE Contracting Officer's Representative (COR): Justin Bashaw
4. U.S. Environmental Protection Agency (USEPA) Project Manager: Gary Collins
5. Contractor Project Manager: Terence Cake
6. Contractor QA/QC Manager: Paul Berman

4.0 ELEMENT A4 - PROJECT/TASK ORGANIZATION

Element A4: Sections 4.1 and 4.2 below contain the project contacts and task organization for open communication during this project.

4.1 Dredging Project Proponent

Applicant: U.S. Army Corps of Engineers, Wilmington District
Project Manager/Technical Point of Contact: Justin Bashaw
USACE, Wilmington District
69 Darlington Ave
Wilmington, NC 28403
Phone: (910) 251-4581
Fax: (910) 251-4744
email: Justin.P.Bashaw@usace.army.mil

Responsibilities:

- Evaluate the need for dredging in MOTSU.
- With the USACE QA Manager, review and approve the Quality Assurance Project Plan (QAPP) prior to contractor mobilization.
- Review and approve the Health and Safety Plan (HSP) prior to contractor mobilization.
- Provide the most recent bathymetry surveys for the proposed areas to be dredged.
- Provide historical data and additional information needed to accomplish the sampling according to the scope of work.
- Review contractor's work and ensure that all required paperwork for final evaluation has been submitted to USACE.
- Act as Contracting Officer's Representative.

Applicant: U.S. Army Corps of Engineers, Wilmington District
QA/QC Manager: Justin Bashaw
USACE, Wilmington District
69 Darlington Ave
Wilmington, NC 28403
Phone: (910) 251-4581
Fax: (910) 251-4744
email: Justin.P.Bashaw@usace.army.mil

Responsibilities:

- Along with the USACE Project Manager, review the draft and final QAPP and approve prior to contractor mobilization.
- Provide recommendations for any project-specific issues arising during field operations or sample analysis.
- Review draft and final reports for any quality control issues that must be addressed before submission of the report to EPA for concurrence.

Regulatory Agency: EPA Region 4
Technical Manager: Gary Collins
EPA, Region 4, Wetlands, Oceans, and Coastal Branch
61 Forsyth Street, SW
Atlanta, GA 30303
Phone: (404) 562-9395
Fax: (404) 562-9343
e-mail: collins.garyw@epa.gov

Responsibilities:

- Review and approve the QAPP prior to contractor mobilization.
- Provide recommendations for any project-specific issues arising during the course of field operations or sample analysis.
- Review the sediment testing report and the evaluation report and give concurrence for offshore disposal per the Green Book (EPA and USACE 1991), Inland Testing Manual (ITM) (EPA and USACE 1998), and SERIM (EPA and USACE 2008) if the results meet offshore disposal criteria.

4.2 Dredging Project Team and Responsibilities

Contractor: Terence Cake, ANAMAR Environmental Consulting, Inc.
Project Manager: Terence Cake
2106 NW 67th Place, Suite 5
Gainesville, FL 32653-1658
(352) 377-5770 Ext 102
e-mail: TCake@anamarinc.com

Responsibilities:

- Manage or delegate and oversee project tasks including:
  - QAPP and HSP preparation
  - Field mobilization and sampling operations
  - Sample preparation and shipping
  - Laboratory coordination
  - Data receipt
  - Data review and validation
  - Report preparation and delivery to client
- Maintain communication with the applicant and regulatory agencies through the life of the project, and detail any issues that may affect the decision-making process and status of the sediment proposed for offshore disposal.

Table 4-1 shows additional subcontractors for this project.

Table 4-1. Additional Subcontractors Providing Services for This Project

Subcontractors and Responsibilities Associated with This Project	
Company and Contact Information	**Area(s) of Responsibility**
Chemistry Laboratory: ALS Environmental Project Manager: Shar Samy 1317 S. 13th Avenue Kelso, WA 98626 Phone: (360) 501-3293 Fax: (360) 636-1068 e-mail: Shar.Samy@alsglobal.com Website: www.alsglobal.com	Laboratory sample preparation and chemical analysis of sediment; sample holding and archiving
Geotechnical Laboratory: Terracon Project Manager: Chris Martin, Sr. 9655 Florida Mining Boulevard West, Suite 509 Jacksonville, FL 32257 Phone: 904-900-6494 Fax 904-268-5255 e-mail: crmartin2@terracon.com Website: www.terracon.com	Laboratory sample preparation and physical analysis of sediment; sample holding and archiving
Toxicology Laboratory: EcoAnalysts (formerly Ramboll Environ) Project Manager: Brian Hester 4729 NE View Drive Port Gamble, WA 98364 Phone: (360) 297-6040 Fax: (360) 297-7268 e-mail: bhester@ecoanalysts.com	Laboratory sample preparation and analysis for suspended phase, solid phase, and bioaccumulation potential.
Vibracore Subcontractor: Athena Technologies, Inc. Project Manager: Neil Wicker P.O. Box 68 McClellanville, SC 29458 Phone: (843) 887-3800 e-mail: neil_wicker@athenatechnologies.com	Vibracore and grab sampling support for field sample collection

Figure 4-1 shows the overall project organization.

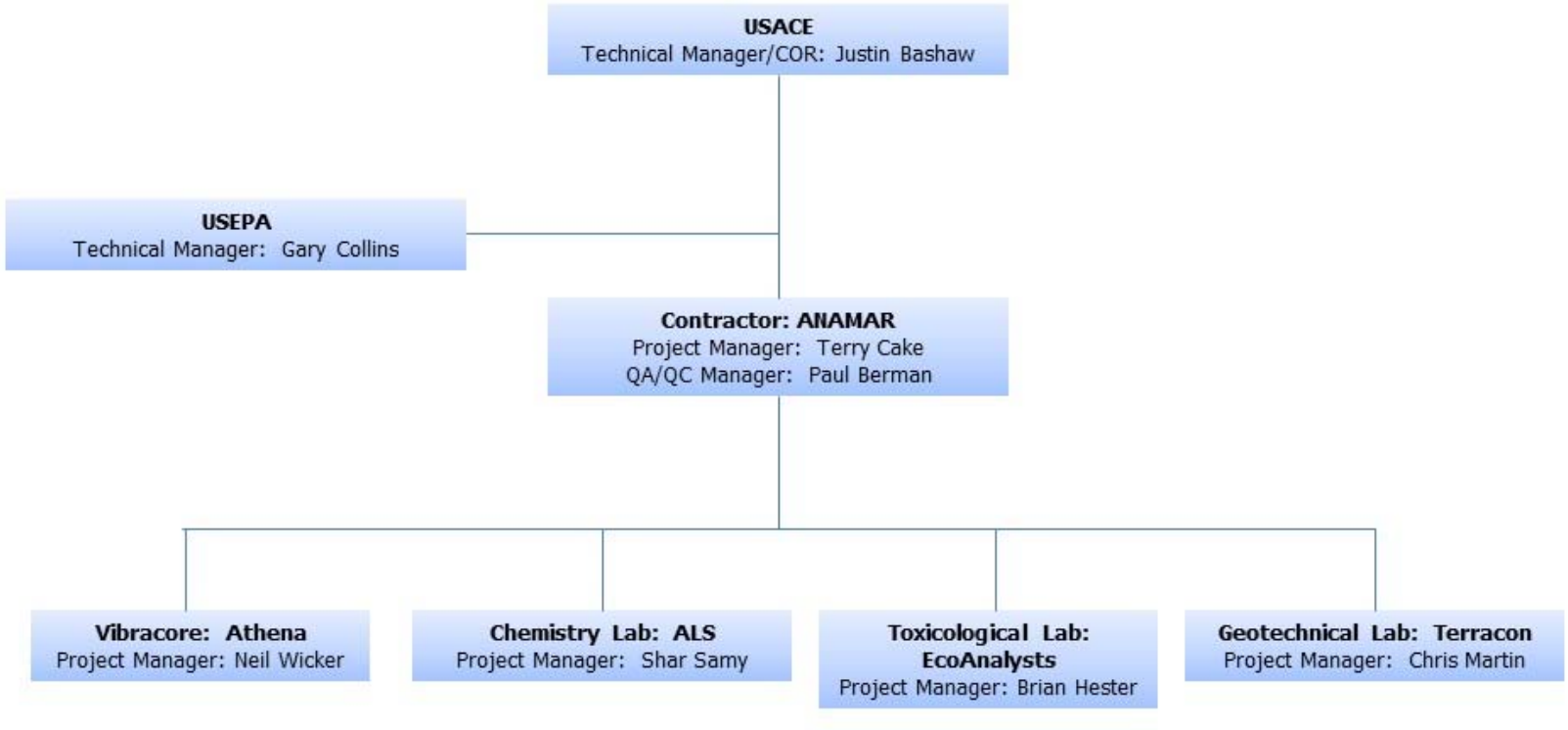

Figure 4-1. Project Organization Chart

5.0 ELEMENT A5 - PROBLEM DEFINITION/BACKGROUND

5.1 Background/Site History

5.1.1 Background

A principal factor in the ability of the Military Ocean Terminal Sunny Point (MOTSU) to accomplish its mission of support to the U.S. Armed Forces is the maintenance condition of the terminal's navigation basins, access channels, and berthing areas. When the MOTSU berths, basins, and channels become shoaled, the immediate capacity of the terminal to transport military materials is reduced and/or delays are incurred until full project capabilities are restored through maintenance dredging. About 1 million cubic yards (mcy) of primarily silt and clay must be removed from MOTSU, typically on an annual basis, to maintain navigable conditions. Excavation is accomplished by clamshell, hydraulic pipeline, or hopper dredge or a combination thereof. MOTSU's main terminal is in the Cape Fear River along the Wilmington Harbor federal navigation project in Brunswick County, North Carolina. It lies on the west bank of the Cape Fear River approximately 10 miles upstream of the river's mouth. Figures 5-1 and 5-2 show the approximate location of the sampling area in North Carolina and the specific area in the Cape Fear River where the dredging units (DUs) are located.

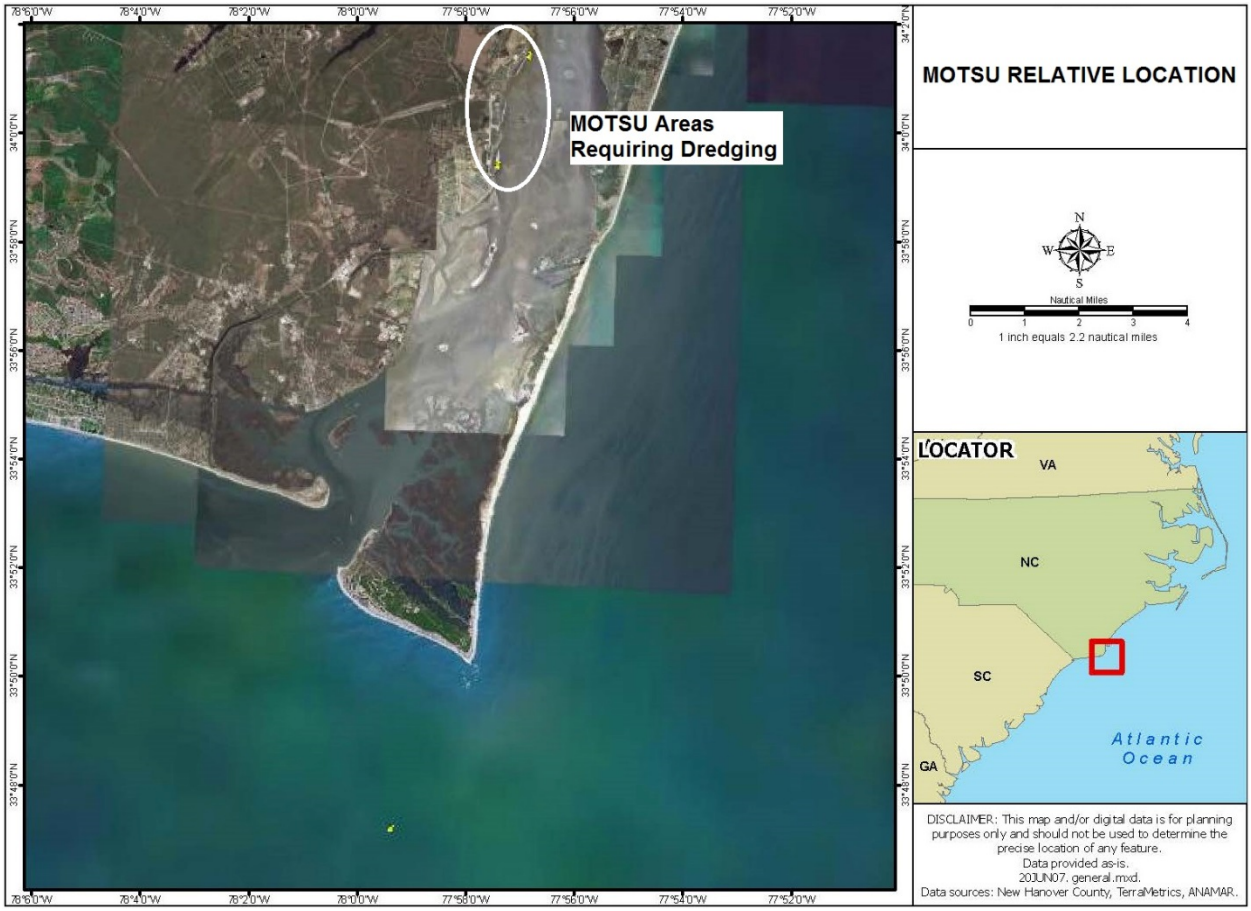

Figure 5-1. MOTSU Location in North Carolina

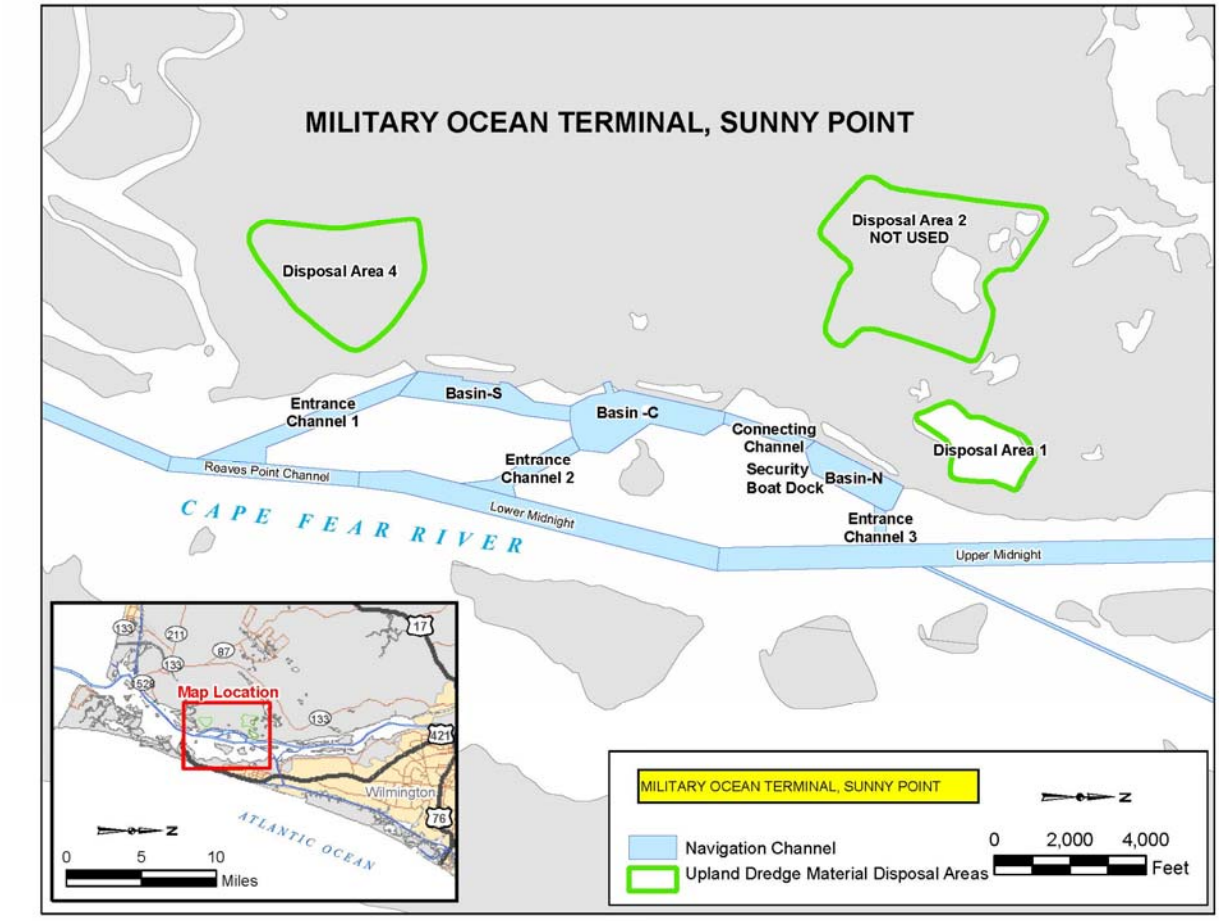

Figure 5-2. MOTSU Dredging Units in the Cape Fear River, North Carolina

5.1.1.1 MOTSU Basin / Access Channel / Berthing Area / Security Boat Dock Maintenance

The Wilmington Harbor navigation channel is a 30-mile-long channel 500 feet wide through the Cape Fear River ocean bar, then 400 feet wide up the river to Wilmington, North Carolina. The Wilmington Harbor channel elevation is currently -44 feet mean lower low water (MLLW) at the ocean bar and -42 feet MLLW upstream to Wilmington. Based on recent evaluations of MOTSU sediments, material (including the Security Boat Dock [SBD]) is generally greater than 10% fines and is typically dredged using a clamshell, hydraulic pipeline, or hopper dredge, or a combination thereof.

The MOTSU port facilities include three wharves approximately 2,500 feet long, three interconnected basins 800 feet wide and varying from 2,800 feet to 4,100 feet in length, and the SBD on the southern end of the north wharf. The entrance channels and connecting channel have bottom widths of 300 feet. Project elevation is -38 feet MLLW plus 2 feet of overdepth for all navigation facilities except the north basin, which is dredged to -34 feet MLLW plus 2 feet of overdepth and the SBD, which is dredged to 12 feet MLLW plus 2 feet of overdepth. The two maintained entrance channels (the south and center entrance channel) connect the MOTSU facilities to the Wilmington Harbor federal navigation channel.

Approximately 1 mcy of typically silt and clay must be removed from MOTSU, principally on an annual basis to maintain navigable conditions. All MOTSU dredge material will undergo Tier III analysis, per U.S. Environmental Protection Agency, Region 4 (EPA) recommendations found in the SERIM.

Because of the recurring quantities of fine-grained materials to be dredged at MOTSU, and the limited capacity to place material in upland disposal sites, a requirement for direct ocean disposal of dredged material in the designated New Wilmington ODMDS is foreseeable, provided necessary regulatory approvals are obtained.

5.1.1.2 Project Depths

Project depth is 38 feet MLLW plus 2 feet of overdepth for all navigation facilities except the north basin, which is dredged to 34 feet MLLW plus 2 feet of overdepth, and the SBD, which is dredged to 12 feet MLLW plus 2 feet of overdepth. Sampling depths for this project are shown in Table 10-2.

5.1.1.3 Allowable Paid and Non-Paid Overdredge and Advanced Maintenance

All areas have 2 feet of allowable paid overdepth dredging.

5.1.2 Dredging History

The ocean disposal of dredged material will occur within the New Wilmington ODMDS. Since 1987, MOTSU dredging has been principally performed by clamshell, hydraulic pipeline, or hopper dredge, or a combination thereof, and it is expected that current maintenance dredging will use a clamshell dredge. The disposal of dredged material will be performed in accordance with the *New Wilmington ODMDS Site Management and Monitoring Plan* (SMMP), originally dated October 2001 and updated in December 2012.

The New Wilmington ODMDS is approximately 5 miles offshore of Bald Head Island and is 9.4 square nautical miles (nm^2) in area. Depths range from 35 to 52 feet below mean low water. The capacity of the New Wilmington ODMDS is approximately 166 mcy, based on fill to -30 feet MLLW. Since its designation in 2002, this ODMDS has been used for placement of dredged materials originating from the Wilmington Harbor federal navigation project and MOTSU. Approximately 1 mcy (mcy) of material is dredged from MOTSU annually, and approximately 1.6 mcy is dredged annually from Wilmington Harbor and placed in the New Wilmington ODMDS.

5.1.3 Historic Testing Results

The following environmental documents (presented chronologically) address aspects of the MOTSU maintenance dredging program and indicate the environmental acceptability of dredging and dredged material disposal methods..

a) U.S. Army Corps of Engineers (USACE), Wilmington District. 1972. *Final Environmental Statement, Military Ocean Terminal, Sunny Point, North Carolina*. Prepared by Coastal Zone Resources Corporation, Wilmington, North Carolina. May 1972.

b) Jones, Edmunds, and Associates, Inc. 1979. *Grain Size Analysis, Bioassays, and Bioaccumulation Potential Assessment, Access Channels and Anchorage Basins, Military Ocean Terminal, Sunny Point, NC*. Prepared under contract to the USACE Wilmington District.

c) USACE Wilmington District. 1980a. *Environmental Assessment, Use of Disposal Area 4 Military Ocean Terminal, Sunny Point, Brunswick County, North Carolina*. April 1980.

d) USACE Wilmington District. 1980b. *Environmental Assessment, Ocean Dumping, Military Ocean Terminal, Sunny Point, Brunswick County, North Carolina*. July 1980.

e) USACE Wilmington District. 1984. Environmental Assessment, Clamshell Dredging, Military Ocean Terminal, Sunny Point, North Carolina. September 1984.

f) USEPA. 1989. *Biological and Chemical Assessment of Sediments from Proposed Dredge Sites in Military Ocean Terminal Sunny Point, North Carolin*a, February 1989.. Prepared for USACE Wilmington District by USEPA Environmental Research Laboratory, Gulf Breeze Florida.

g) Battelle. 1993. *Ecological Evaluation of Proposed Dredged Material from Wilmington Harbor and Military Ocean Terminal Sunny Point, North Carolina, July 1993*. Prepared for USACE Wilmington District by Battelle, Marine Science Laboratory, Sequim, Washington.

h) USACE, Wilmington District. 1994. *Final Environmental Impact Statement, Harbor Improvements, Military Ocean Terminal, Sunny Point, North Carolina.* November 1994.

i) EA Engineering, Science and Technology, Inc. 1996. *Results of Chemical Analyses of Sediment Samples from Wilmington Harbor, North Carolina, October 1996*. Prepared for USACE Wilmington District by EA Engineering, Science and Technology, Inc., Sparks, Maryland.

j) Normandeau Associates, Inc. 2003. *Analytical Characterization Report of Proposed Excavated Material at the Military Ocean Terminal Sunny Point, October 2003*. Prepared for USACE Wilmington District by Normandeau Associates, Inc, Spring City, Pennsylvania.

k) ANAMAR Environmental Consulting, Inc. 2007. *Evaluation of Dredged Material Proposed for Ocean Disposal, Military Ocean Terminal, Sunny Point, North Carolina, October 2007*. Prepared for USACE Wilmington District by ANAMAR Environmental Consulting, Inc, Gainesville, Florida.

l) ANAMAR Environmental Consulting, Inc. 2011. *Evaluation of Dredged Material Proposed for Ocean Disposal, Military Ocean Terminal, Sunny Point, North Carolina, September 2011*. Prepared for USACE Wilmington District by ANAMAR Environmental Consulting, Inc. Gainesville, Florida.

5.1.4 Local Activities

MOTSU's primary activity is to support the shipping of personnel and materials for the military into and around the Cape Fear River/Wilmington area. Shoaling impairs the movement of shipping within the area, and it is critical that MOTSU be maintained to proper project depth.

5.1.5 Site History

5.1.5.1 Prior Section 103 Evaluations

Sediment test results from 2007 demonstrated that the dredge material met all ocean disposal criteria specified by EPA. Although testing was performed prior to the release of the SERIM, the 2007 protocols for this project were similar to later guidelines in the SERIM. Sampling and analysis in 2011 were performed for confirmatory evaluation and included sediment chemistry and physicals results only.

Sediment Chemistry Results

Only arsenic and nickel exceeded the TEL or ERL across both projects. All other constituents tested (PAHs, pesticides, PCBs, dioxins, and organotins) were either not detected or were below any screening criteria. Sediment chemistry results were used primarily to determine required tissue chemistry analyses and were not used to determine whether the sediment met ocean disposal criteria.

Elutriate Chemistry Results
No results exceeded the criteria maximum concentration (CMC) for any chemical constituent tested.

Tissue Chemistry Results
No result for any constituent tested exceeded the FDA Action Levels. Results for several metals and PAH compounds did statistically exceed those of the reference; however, these were addressed in the evaluation report provided by USACE to EPA for review.

Benthic Toxicology
For the two species tested, *Leptocheirus plumulosus* and *Neanthes arenaceodentata*, no test result exceeded the mortality limit specified in the Green Book.

Suspended Particulate Phase Toxicology
Results were used to determine the dredge volume that may be disposed of in the ODMDS for any single barge load. The ADDAMS model found that a dredge volume of 4,800 cy per each barge load could be disposed of in the ODMDS.

5.1.5.2 Discharges

To determine the discharges that may have affected the sediment proposed for ocean disposal, two categories, water and wastes, were selected, and each facility permitted by EPA for discharge was checked to determine if there had been any discharges or violations of the permit. The online version of this map is interactive and may be viewed at http://www.epa.gov/enviro/emef/. An EnviroMapper query shows permitted discharges in the immediate area. A complete list of these discharges may be found at https://map11.epa.gov/myem/efmap/index.html?ve=12,34.23497009277344,-77.94599151611328&pText=Wilmington,%20NC and manually shifting the location in the image 17 miles south to the MOTSU facility.

A review of the EnviroMapper data shows discharges over the preceding 3 years at several facilities. Violations included discharges of oils from MOTSU over two quarters in 2014, and BOD, chlorine, ammonia nitrogen, and microbiological contaminants above regulatory limits in 2015 from three facilities. Testing for organic compounds identified in Section 13 of this document will evaluate the material for the potential contamination from the oil discharge violations. The other violations do not have an impact on ocean disposal of dredged material.

5.1.5.3 Toxic Releases

A USCG National Response Center query for MOTSU was conducted and revealed reports of 103 toxic releases in water since the most recent Section 103 confirmatory testing in 2011. The reports indicate that the contaminants were primarily fuels or oils of unknown sources that left a sheen on the water surface. Testing samples for these potential contaminants is covered by the analytical requirements shown in Section 13.

5.2 Identification of Principal Data-Users and Decision-Makers

Table 5-1 shows the principle data-users and decision-makers for this project.

Table 5-1 Principal Data-Users and Decision-Makers

Agency/ Organization	Location	Area(s) of Responsibility
USACE	Wilmington, NC	Responsible for maintenance of MOTSU and manage the New Wilmington Harbor ODMDS.
EPA Region 4	Atlanta, GA	Evaluate compliance of project with ocean dumping criteria and, if applicable, give concurrence to environmental requirements of dredged sediment for approval of offshore disposal per • *Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual* by USEPA/USACE 1991 (Green Book), • *Southeast Regional Implementation Manual, Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coastal Waters* by USEPA/USACE 2008 (SERIM) • *Evaluation of Dredged Material Proposed for Discharge in Water of the U.S. – Testing Manual. Inland Testing Manual* by USEPA/USACE in 1998 (ITM). *Evaluation* Manage the New Wilmington Harbor ODMDS.

6.0 ELEMENT A6 - DREDGING PROJECT/TASK DESCRIPTION

6.1 Purpose/Background

6.1.1 General Purpose of Project

Under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (Public Law 92-532), environmental assessments must be conducted to determine the suitability of the sediment for ocean disposal. The proposed dumping must be evaluated using criteria published by EPA in Title 40 of the Code of Federal Regulations, Parts 220-228 (40 CFR 220-228) (hereinafter, the regulations). Specific testing methods are described in the Green Book and (ITM). ANAMAR will collect sediment samples and subcontract analyses for physical/chemical, toxicological, and bioaccumulation parameters as required in the Green Book and the SERIM. The SERIM provides specific guidance on procedures to be followed when assessing the suitability of MOTSU dredged material for ocean disposal.

Dredged material from MOTSU that is not placed within available upland disposal areas is disposed of within the New Wilmington ODMDS. The New Wilmington ODMDS was designated by EPA pursuant to MPRSA Section 102(c) as a suitable site for ocean disposal of dredged material. The final rule was promulgated by EPA on July 5, 2002 (F.R. Vol 67 No. 129), effective September 5, 2002. The disposal of dredged material must be performed in accordance with the New Wilmington ODMDS SMMP, dated December 2012.

6.1.2 Permitting

Along with concurrence from EPA, a permit from the Department of the Army will be required for maintenance dredging from MOTSU.

6.2 Description of the Sampling and Analysis

6.2.1 Measurements That Are Expected during the Course of Sediment Sampling

Table 6-1 shows a summary of the analytical requirements for testing that will be performed for this project. A complete list of individual samples and their analytical requirements is shown in Sections 10.4.3 and 13.3.

Table 6-1. Summary of Analytical Requirements for Physical, Chemical, and Toxicological Testing

FIELD SAMPLE COLLECTIONS:
3 composite samples (1 composite sample per DU) + 1 reference area sample = 4 composite samples
1 site water samples for elutriate preparation

IN SITU MEASUREMENTS:

Measured at the water sampling locations	Conductivity
Water temperature	Salinity
Turbidity (NTUs)	Water depth
pH	Weather conditions
Dissolved oxygen	Sea state

PHYSICAL ANALYSIS:

Grain size testing for subsamples	Specific gravity
Grain size testing, including hydrometer for composite samples	Total solids
	Atterberg limits

SEDIMENTS (on composite sediment samples):	**ELUTRIATES AND SITE WATER: (using the composite sediment samples)**
Metals	Metals
Pesticides	Pesticides
Polychlorinated biphenyls (PCBs) (congeners and Aroclors)	PAHs
Polynuclear aromatic hydrocarbons (PAHs)	Ammonia
Organotins	Elutriates will be made using site water
Total petroleum hydrocarbons (TPH)	
Ammonia	
Total organic carbon (TOC)	
Dioxins and furans	

BIOASSAY AND BIOACCUMULATION TESTS:
Suspended Particulate Phase Toxicity Testing. Test durations will be 96 hours (survival) and 48 hours (development) and will use the following species (based on availability):

- *Menidia beryllina* (Inland Silverside)
- *Americamysis bahia* (Mysid Shrimp)
- Recommended larval species: *Mytilus edulis* (mussel), *Crassostrea virginica* (Eastern Oyster), *Strongylocentrotus purpuratus* (Purple Urchin), or *Arbacia punctulata* (Purple-spined Sea Urchin)
- *Mytilus galloprovicialis* (if none of the recommended larval species are available)

Solid Phase Toxicity Testing. Test duration will be 10 days and will use the following species (based on availability):

- *Leptocheirus plumulosus* or *Ampelisca abdita* (amphipod)
- *Neanthes arenaceodentata* (polychaete)

Bioaccumulation Testing. Test duration will be 28 days and will use the following species:

- *Macoma nasuta*
- *Neanthes virens*

CHEMICAL ANALYSIS OF TISSUES:
Analysis of bioaccumulation test organism tissues for USACE-selected contaminants of concern (COCs). Tissues will be analyzed for percent moisture, percent lipids, and selected contaminants based on results of sediment chemical analyses. Direction on target analytes for tissue analyses will be provided before the end of the 28-day exposure period.

6.2.2 Applicable Technical Quality Standards or Criteria

Sediment results will be compared to published sediment screening values where appropriate. These levels are the threshold effects level (TEL) and the effects range-low (ERL). The TEL represents the concentration below which adverse effects are expected to occur only rarely, and the ERL is the value at which toxicity may begin to be observed in sensitive species (Buchman 2008). Comparisons will be used for reference only, not for any regulatory decisions.

Elutriate and site water results will be compared to the EPA National Recommended Water Quality Criteria Criterion Maximum Concentration (CMC). The CMC is an estimate of the highest concentration of a pollutant in saltwater to which an aquatic community can be exposed briefly without resulting in an unacceptable effect (EPA 2006).

Tissue chemistry results will be compared to reference values and U.S. Food and Drug Administration (FDA) action levels (USFDA 2015). For tissues above reference, ecological effects threshold and South Atlantic Bight Background concentrations will be used for comparison. These comparison limits may be found in Appendix H of the SERIM. Results may also be used in a risk-based evaluation if they exceed reference concentrations and Region 4 bioaccumulation table values.

Toxicology results will be compared to the applicable survival and development criteria from the SERIM and the Green Book. Results from the suspended particulate phase will be used in the STFATE model to determine the maximum dredge disposal volume as described in Section 19 of this document.

6.2.3 Special Personnel or Equipment Requirements That May Indicate the Complexity of the Dredging Project

All sediment samples will be collected by grab sampler. Refer to Section 11 for a discussion of all sampling techniques and equipment that will be used for this project. All field personnel will be familiar with the use of the sampling equipment or will work under the direct supervision of more experienced personnel. There will be an experienced field team leader from ANAMAR assigned to the project who is familiar with the sampling design and data quality objectives. Section 8 includes a discussion of personnel training requirements.

6.2.4 Assessment Techniques Needed for the Dredging Project

This project involves the collection of estuarine and marine sediment samples in a portion of the MOTSU area. This is a one-time sampling event (i.e., no long-term maintenance or measurements). The fieldwork can be accomplished in 2-3 days. Section 10.4 describes procedures for locating and selecting environmental samples. Laboratory testing will include physical and chemical analysis of sediment samples. The assessment techniques stated in Sections 14 through 24 are adequate to provide sufficient assurance that the quality objectives of the project will be met.

6.2.5 Schedule for the Work Performed

Table 6-2 shows an estimated sampling, analysis, and reporting schedule for the sampling event.

Table 6-2. Estimated Work Schedule

Responsibility	Estimated Schedule from Contract Approval to Field Sampling	Calendar Days	Calendar Date
USACE	Contract Approval and Notice to Proceed	0	4/11/17
ANAMAR	Submit draft QAPP for review	10	4/21/17
ANAMAR	Respond to comments and submit final QAPP for approval and signatures	27	5/8/17
ANAMAR	Commence fieldwork	34	5/15/17
ANAMAR	Complete fieldwork and submit samples to laboratories for analysis	41	5/22/17
ANAMAR	Receive laboratory reports for physical and chemical analysis of sediment samples	73	6/23/17
ANAMAR	Determine analytical requirements for tissue chemistry	76	6/26/17
ANAMAR	Receive final toxicology and tissue chemistry reports from laboratory	111	7/31/17
ANAMAR	Prepare draft sediment report for submission to USACE	142	8/31/17
ANAMAR	Following receipt of comments from USACE, prepare final report for submission to EPA for concurrence	TBD	TBD
Any additional responses to USACE or EPA will be completed in a timely manner to be determined at the time of the request.			

6.2.6 Dredging Project and Quality Records Required, Including the Types of Reports Needed

The following documents must be submitted:

1. Draft Sampling and Analysis Plan/ Quality Assurance Project Plan (SAP/QAPP) submitted for review and comment. USACE will submit to EPA for final approval and the contractor will update and submit the plan in accordance with any comments for final approval.
2. Site-specific Health and Safety Plan – Accident Prevention Plan
3. Preliminary Sediment Chemistry Data Report
4. Final testing report to include all elements and required formats specified by USACE and EPA Region 4, including
   - A report narrative addressing all aspects of field sampling and laboratory analysis, discussion of laboratory results, a review of all laboratory quality of control, and ADDAMS model results
   - Laboratory results provided in condensed data tables
   - Maps of the sampling sites
   - Photographs of the samples as collected
5. Chemical Quality Assurance Report (CQAR). The CQAR's purpose is to evaluate all representative data from the project field sampling and laboratory analyses. For each group of data, a data review checklist is completed that assesses daily field QC reports and specific QC chemical data quality indicators, and it enables the reviewer to identify potential problem areas that may require additional data validation. The CQAR identifies non-conformances, QC deficiencies, or other problems that would affect the data quality objectives as specified in the work plan and the QAPP. The CQAR summarizes the overall usability of the data for the intended purposes. This report will be an appendix to the final sediment testing report (see item four, above).
6. Copies of all field paperwork, including:
   - Sediment collection data sheets for grabs specifying the sample location, date and time of sample collection, sampling conditions, a brief sample description, and in situ measurements
   - Water sampling field sheets (includes in-situ parameters)
   - Daily temperature logs
   - Chain-of-custody forms
   - Calibration logs
   - Composite logs
   - Daily Quality Control Reports (DQCR). A DQCR will be prepared by the field team leader or project manager for each day sampling is conducted. This report will contain a description of the work performed, samples collected, general conditions, corrective actions taken, departures from the sampling plans, and any other notes or comments that will document the day's activities.

7.0 ELEMENT A7 - QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Table 7-1 below shows the key quality control indicators that will be reported by the laboratories for this project.

Table 7-1. Quality Control Activities Performed for Field, Physical, Chemical, and Toxicological Analysis

QC Check	Information Provided
In situ Measurements	Provides onsite conditions at the time of sample collection
Initial Calibration	Ensures instrument is operating correctly
Initial Calibration Verification (ICV) Initial Calibration Blank (ICB)	Ensures instrument calibration will yield correct responses at a known concentration. This increases confidence that sample readings within the calibration range also are read correctly.
Method Blank (MB)	Ensures that the preparation and analysis of the samples is not introducing potential contaminants through either the reagents used or other sources found through the laboratory
Standard Reference Material (SRM)	Provides a known concentration of contaminant that can be used to verify the preparation and analysis of samples. The SRM should be as closely matched to the sample matrix as possible.
Laboratory Control Sample/Laboratory Fortified Blank (LCS/LFB)	Provides a clean matrix sample that may be used to determine the instrument's calibration is within acceptance limits.
Continuing Calibration Standard (CCV) Continuing Calibration Blank (CCB)	Verifies that the initial calibration is within control, and that any drift is within acceptable limits.
Surrogates	Verifies the analysis of the individual contaminants performed by the analytical method.
Duplicates/Triplicates	Measures the precision of the analytical technique and can be used to determine the relative homogeneity of the sample.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Used to measure the analytical bias of the test and determine if there are any matrix interferences in the sample.
Control Sample	The control sediment is used to ensure that organisms used in toxicological analyses are sufficiently healthy for analysis. The control sediment used by EcoAnalysts is from the same habitat as the organisms used for analysis.
Reference Sample	Provides a background sample roughly equivalent to the disposal site.
Site Water Analysis	Provides background levels for comparison to the elutriate samples.
Toxicological Dilutions	Provides a means for correctly calculating the EC_{50} and LC_{50} determined by the water column test
Daily Reading for Toxicological Conditions	Ensure that test conditions are acceptable on a continuing basis for toxicological analysis.

8.0 ELEMENT A8 - SPECIAL TRAINING REQUIREMENTS/ CERTIFICATION

All sampling and fieldwork must conform to the USACE Safety Manual EM 385-1-1 (USACE 2014). All field personnel must be trained and have proof of certification in cardio pulmonary resuscitation and first aid. Certification must be updated every 2 years for both.

All laboratory personnel are required by the National Environmental Laboratory Association Conference (NELAC) to have a signed and dated initial demonstration of capability for any analysis they perform. Each initial demonstration of capability must be updated annually.

All operators of the sampling equipment receive training prior to leading any field sampling effort. Training protocols for each field team are described below.

ANAMAR Field Sampling Training

All sampling activities will be performed under the direct supervision of the ANAMAR field team leader. These activities are described in Section 11 and include: knowledge of health and safety requirements, maneuvering the sampling vessel to the correct sampling location, decontamination of all sampling equipment, checking water and sampling depth, collecting grab sediment and water samples using the correct equipment, ensuring that samples are containerized and stored properly, and ensuring that all field paperwork is filled out completely. Any failures to meet the requirements set forth in the QAPP must be documented on the sampling field sheets or the DQCR.

Sampling in MOTSU will be led by a field team leader with a minimum of 5 years of sampling experience similar to that required for this effort. Field assistants may also accompany the team leader and assist with any field activity under the direct supervision of the team leader. Field assistants will have a minimum of 6 months of work experience at ANAMAR.

Athena Field Sampling Training

Training for Athena sample collection includes a 2-week period in which an Athena field leader instructs new hires on operation and maintenance of the vibracore unit and deployment of sample barrels in the field. Additional training for environmental projects includes decontamination techniques, maintaining a clean and secure work area to prevent potential cross-contamination, and use of personal safety gear. Prior to mobilization, discussions are held in staff meetings to determine each crew member's role and expected site conditions that may affect vibracore operations and sediment collection. Athena provides one-on-one instruction and free discussion of sampling methodologies and ways to improve the system.

To become a field team leader who makes final decisions regarding all operations in the field, a person must accumulate at least 2 years of vibracoring experience and demonstrate to the company's professional geologist knowledge of vessel operations, vibracore operation and field repair, equipment decontamination, navigation and positioning (HYPACK, DGPS, RTK), sample processing, and reporting of field data.

9.0 ELEMENT A9 - DOCUMENTATION AND RECORDS

Element A9 encompasses the information in Sections 9.1 through 9.3, below.

9.1 Reporting of Results

The preferred format for the sediment testing report, including physical and chemical data, is provided in Appendix D of the SERIM. The draft and final reports shall present all aspects of evaluations of the dredged material required under MPRSA Section 103 as described in the Green Book (USACE/EPA 1991) and shall present the results of field sampling, physical/chemical analyses of sediment, toxicological testing, and bioaccumulation exposures as outlined in Appendix D of the SERIM.

The draft and final testing reports will undergo internal technical review and QA review by persons with appropriate technical qualifications to ensure that the report meets the project requirements specified in the technical work plan and the QA goals.

The reports will consist of 8½" by 11" pages with drawings or oversized tables folded, if necessary, to this size. The report margins shall be suitable for use in a durable 3-ring binder. A decimal numbering system will be used, with each section having a unique decimal designation. Reports that require extensive editing, have extensive errors, or are not in the required formats will be rejected and re-submittal will be required. Any maps, drawings, figures, sketches, databases, spreadsheets, or text files prepared for this report shall be provided in both hard copy and digital form.

The digital copies of reports and other text documents shall be provided in Microsoft Word 2003 (or higher version). Spreadsheet files and data files shall be provided in Microsoft Excel 2003 (or higher version) format. All text, spreadsheet, and database files shall be delivered in compact disk read-only memory (CD-ROM or DVD) with ISO-9660 format. Level IV laboratory data should be provided as Adobe Acrobat PDF files. Geographic data shall be provided in feet and projected into the State Plane NAD83 coordinate system.

Drawings or plates shall be no larger than 11 inches by 17 inches with sufficient margin for binding on the left side and shall include a geographical scale.

9.2 Report Format

Draft reports will consist of two hardcopies and two electronic copies provided in Microsoft Word and Adobe Acrobat PDF format on discs. Final reports will consist of five hardcopies and five electronic copies provided in Microsoft Word and Adobe Acrobat PDF format on discs. Appendices, such as laboratory data, will be provided only as electronic files on discs in order to reduce the size of the hard-copy versions of reports.

The content or data represented is specified in the basic scope of work. The format for electronic files being delivered as part of any USACE contract are described below and do not specify content or what the electronic files should contain. In addition to the formats described in Section 9.1, the following formats will be used for supplemental files submitted as part of the report.

1. Digital Mapping and Data Standards: USACE Wilmington District uses Microstation for computer assisted drafting and design, CADD. Data provided must be readable by Microstation SE or higher to provide design drawings, sketches, or figures. All digital files provided in Microstation shall be provided in feet and projected into the North Carolina

State Plane coordinate system. The maps shall use the GRS 1980 spheroid and the North American Datum 1983 (WGS-84, and shall be provided on optical discs).

2. Geographic Information System (GIS) Data Delivery Format
    a. Digital geographic maps and the related digital information shall be developed using double precision and delivered in uncompressed ARC/INFO export file format (.e00) using ARC/INFO Release 8.0 or higher. The Wilmington District will also accept ARC/View Shapefiles. These file formats are geographic information system software applications produced by the Environmental Systems Research Institute of Redlands, California, and are in the GIS software suite used by U.S. Army Corps of Engineers, Wilmington District.

    b. b. Digital geographic maps and the related digital information shall be usable on an IBM-compatible personal computer system using the Windows 7 or newer operating systems. This data shall be provided on optical discs with ISO-9660 format.

3. General Digital Standard for CADD and GIS Files
    a. Geographic data shall be provided in feet and projected into the North Carolina State Plane coordinate system. The maps shall use the GRS 1980 spheroid and the North American Datum 1983 (WGS-84). Vertical upland topographic surveys shall use NGVD 1988. Hydrographic survey will reference the local dredging datum which will be provided in the project scope of services. No offsets shall be used. Each map layer or coverage shall have a projection file. Map or drawing scales will be determined by the contracting officer's representative for the contract. Mapping accuracy for the agreed scales will conform to the American Society for Photogrammetry and Remote Sensing (ASPRS), "Accuracy Standards for Large-Scale Maps" and "Interim Accuracy Standards for Large-Scale Maps" (ASPRS, 1991). Copies of the ASPRS Accuracy Standards can be obtained by contacting

        American Society for Photogrammetry and Remote Sensing
        5410 Grosvenor Lane, Suite 210
        Bethesda, MD 20814-2160

    b. Geographic data must be provided in a form that does not require translation, pre-processing, or post-processing before being used in USACE's system. However, the contractor shall consult with the government (specifically the GIS Coordinator) concerning the use of alternative delivery formats such as MicroStation SE or higher to provide design drawings, sketches, or figures. All digital files provided in Microstation shall be in the same projection and use the same coordinate system, datum, and units as stated above, and shall be provided on optical discs.

    c. Geographic Data Structure: All geographic information shall be developed in a structure consistent with the Spatial Data Standards (SDS), Version 1.9, released in December 1999, or a higher version if available at the time of this project. The contractor shall consult with the government concerning modifications or additions to the SDS. The government may approve modifications to the standard if it is determined that SDS does not adequately address subject data sets. Copies of the SDS may be obtained by contacting:

U.S. Army Corps of Engineers,
Engineer Research and Development Center
CAD/BIM Technology Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

d. Geographic Data Documentation: For each digital file delivered containing geographic information (regardless of format), the contractor shall provide documentation consistent with the "Content Standards for Digital Geospatial Metadata, June 1998" published by the Federal Geographic Data Committee. The documentation shall include but is not limited to the following: the name and description of the map layer or coverage, the source of the data and any related data quality information such as accuracy and time period of content, the type of data coverage (point, line, polygon, etc.), the field names of all attribute data and a description of each field name, the definition of all codes used in the data fields, the ranges of numeric fields and the meaning of these numeric ranges, the creation date of the map layer and the name of the person who created it. A point of contact shall be provided to answer technical questions. A metadata generation software, called Document.aml, is available from ESRI for use with ARC/INFO to help in the production of the required metadata. Corpsmet 95 metadata software is available from the U.S. Army Geospatial Clearinghouse at http://corpsgeo1.usace.army.mil/.

   Copies of the FGDC metadata standard can be obtained by contacting:

   FGDC Secretariat
   c/o U.S. Geological Survey
   590 National Center
   Reston, Virginia 22092
   (703) 648-5514

   FGDC metadata standards can also be found on the Internet at http://www.fgdc.gov

e. Geographic Data Review. The digital geographic maps, related data, and text documents shall be included for review in the draft and final contract submittals. The reviews may include a visual demonstration of the geographic data on the Windows computer system in the Environmental Resources Section GIS Unit's. Actual installation of the digital data from the optical disc onto the computer will be conducted by GIS Unit personnel. However, the contractor shall have a technical consultant available at each review to assist with any digital data discrepancies. The data will be analyzed for subject content and system compatibility. Review comments to data and text shall be incorporated by the Contractor prior to approval of the final submittal.

f. Ownership. All digital files, final hard-copy products, source data acquired for this project, and related materials, including that furnished by the Government, shall become the property of U.S. Army Corps of Engineers, Wilmington District and will not be issued, distributed, or published by the Contractor.

9.3 Data Reporting Package Archiving and Retrieval

Records for dredging projects are typically held for a minimum of 5 years after the final report has been submitted. Prior to disposal of any records, the contractor must contact the client (USACE-Wilmington) for authorization and direction in the disposal of said documents.

GROUP B. PROJECT MANAGEMENT

10.0 ELEMENT B1 - SAMPLING PROCESS DESIGN

Element B1 encompasses the information indicated in Section 10.1 through 10.6, below.

10.1 Scheduled Dredging Project Activities, Including Measurement Activities

Sampling will take place prior to the next scheduled maintenance dredging event. Sampling is expected to last 2-3 days.

10.2 Rationale for the Design

Previous testing (discussed in Section 5.1.3) indicates that there are low concentrations of COCs found in sediments from MOTSU DUs. In addition, the toxicological results show relatively high survival and normal development from sediments previously tested in the MOTSU DUs. The most recent testing from 2011 used confirmatory testing protocols throughout the MOTSU DUs, extending concurrence from the material evaluated in 2007. The DUs for this project were developed by USACE and EPA and have been used historically for dredging in this area. All samples will be collected using grab samplers. Section 11 provides a description of each collection type and the procedures to be followed during collection.

The annual estimated maintenance dredging volume for the MOTSU area is 1 mcy and is expected to be predominantly silt and clay. This estimate is based on previous dredging volumes and includes portions of the allowable 2-foot overdepth.

The Green Book (Section 8.2.3) and the SERIM recommend that areas proposed for dredging should be subdivided into project segments or DUs for sampling. Each DU is expected to have relatively consistent characteristics, even if the characteristics of the material varies over the dredging area. If warranted, dredged material from each DU could be managed in different manners during dredging and disposal to limit environmental impact and can be selected based on historical data, sediment characteristics, geographic configuration, depth of cut, equipment limitations, known or suspected contaminant concentrations, etc. They can also be defined by horizontal and vertical limits, e.g., surface sediments might be considered separately from subsurface sediments at the same location. Typically, a DU can be characterized by a single sediment sample and analysis.

The SERIM discusses four possible rankings for DUs: exclusionary, low, moderate, or high. In that order, these ranks represent a scale of increasing potential for significant concentrations of COCs and/or adverse biological effects.

- **Exclusionary.** Material that has been shown to meet the exclusionary criteria in 40 CFR §227.13(b) is summarized below: (1) the material is predominately sand (see Section 3.1.1) and is found in areas of high current or wave energy, or (2) the material is substantially the same as the substrate at the ODMDS and the dredging site is far removed from known existing and historical sources of pollution.
- **Low.** (1) Available data indicate low concentrations of COCs and/or no significant response in biological tests; (2) locations with higher percentages of finer-grained sediments and organic material but few sources of potential contamination; (3) typical locations include adjacent entrance channels, rural marinas, navigable side sloughs, and small community berthing facilities.

- **Moderate.** (1) Available data indicate moderate concentrations of COCs in sediments in a range known to cause adverse response in biological tests; (2) locations where sediments are subject to several sources of contamination or where existing or historical use of the site has the potential to cause sediment contamination; (3) typical locations include urban marinas, fueling and ship-berthing facilities, areas downstream of major sewer or stormwater outfalls, and medium-sized urban areas with limited shoreline industrial development.
- **High.** Available data indicate high concentrations of COCs in sediments and/or significant adverse responses.

The exclusionary, low, and moderate rankings are most applicable to MOTSU channel sediments. The sampling for this project will be focused on the portion nearest land and the harbor entrance. Previous Section 103 evaluations of MOTSU sediments have indicated that the material is acceptable for ocean disposal. The DUs for this project have been historically used for evaluation.

Specific reaches for this project are identified in Table 10-1. The quantity estimates were based on current condition surveys and include the maximum project depth being considered with advance maintenance and maximum allowable overdepth dredging. Each DU will be represented by one composite sample of five subsamples.

Table 10-1. Dredging Units, Project Elevation and Volumes, and Number of Subsamples

Dredging Unit	Project Elevation	Estimated Volume	Number of Samples
MOTMA17-N (North Basin)	-34 feet MLLW + 2 ft allowable overdepth	1,000,000 cy (across all three dredging units)	1 composite of 5 subsamples
MOTMA17-S (South Basin)	-38 feet MLLW + 2 ft allowable overdepth		1 composite of 5 subsamples
MOTMA17-C (Center Basin)	-38 feet MLLW + 2 ft allowable overdepth		1 composite of 5 subsamples

10.3 Design Assumptions

Assumptions used for the creation of this SAP/QAPP include the following:

1. The contractor will have access to each sampling site.
2. If subsamples cannot be collected within the sampling design and need to be relocated based on logistical concerns, the contractor must first obtain approval from the USACE Technical Manager prior to any deviations from this sampling plan. Any deviation will be explained in the DQCR, the field sheets, and the testing report.
3. The surveys (bathymetry data) are current, accurate, and the most recent available. Possible foreseen problems and solutions include the following:

   Problem: Rock at a depth not allowing sample collection.
   Solution: Relocate sample station or sample using a different technique.

   Problem: Mooring of a ship or barge at a sampling location.
   Solution: Relocate sample station or attempt to get ship moved to provide access.

   Problem: Heavy traffic in the channel or turning basin area limiting sample collection.

Solution: Relocate sample station(s), postpone sampling, or sample around traffic (safety dependent).

Problem: Weather (hurricane, lightning, etc.) or rough seas.
Solution: Postpone sampling until the weather clears.

Problem: Sampling depth is significantly different (±3 feet) from bathymetric readings.
Solution: The field crew will relocate the sampling site(s) to ensure that samples from representative areas are collected. If sites above project depths cannot be located, a member of the field team will contact the USACE representative to determine corrective action.

Note that there is no way to accurately predict every problem that may arise when in the field. Every effort will be taken to inform the USACE Technical Manager or the QA Manager of any changes in the sampling scheme prior to the change taking place. The contractor Project Manager and the Field Team Leader will be familiar with the project and project goals and make an educated, scientifically based decision on the change if the USACE Technical Manager, QA Manager, or the USEPA Project Manager cannot be contacted. Any deviation will be explained in the DQCR, on the field sheet(s), and in the testing report.

10.4 Procedures for Locating and Selecting Environmental Samples

Sediment sampling sites are listed in Table 10-2. Samples are to be collected from locations within the dredging prism of the MOTSU DUs. The sampling depth must be documented in the sample logs. Site water for background chemical analysis and for generation of elutriates will be taken from one location near sample MOTMA-C-B, which is centrally located in the MOTSU dredging area. Five subsamples from each dredging unit will be collected and composited into three separate samples to undergo Tier III analysis.

The selected reference station is in the Atlantic Ocean and corresponds to Reference Station D for the New Wilmington ODMDS in Appendix K of the SERIM and will be analyzed for physicals, sediment chemistry, benthic toxicology, bioaccumulation, and tissue chemistry, but not for elutriate analysis or suspended particulate phase toxicology.

To obtain the grab samples, Athena's vessels will be used. The vessel and project schedule will be arranged with the project Technical Manager. The contractor's crew will operate all sampling equipment, and all work will be conducted in accordance with the approved HSP to ensure safety. Transportation to and sampling at the reference site will be the responsibility of the contractor.

Hydrographic Surveys
The sampling maps provided in Attachment 1 include the most recent bathymetric data. Bathymetry is used to estimate sample depths, sample volumes, and sampling locations.

10.4.1 Nomenclature

Sample and subsample nomenclature, coordinates, sample type, and target sample depths are provided in Table 10-2.

Table 10-2. MOTSU Sampling Stations

Sample ID	Subsample	Coordinates, NC State Plane NAD83		Sample Type	Grab Sample Collection from	Project Elevation (ft MLLW)
MOTMA17-N	A	2319335	100938	Grab	Sediment Surface	-36
	B	2319524	100510			
	C	2318855	100064			
	D	2318974	99573			
	E	2318361	99225			
MOTMA17-C	A	2317809	95622	Grab	Sediment Surface	-40
	B	2317436	95036			
	C	2317669	94503			
	D	2318174	93781			
	E	2317098	93766			
MOTMA17-S	A	2317397	91254	Grab	Sediment Surface	-40
	B	2317123	91127			
	C	2316794	90942			
	D	2317053	90031			
	E	2317077	89485			
Reference Area						
MOTMA17 (Reference)	A	2307149 (all stations within 300–500 ft from coordinates)	14984 (all stations within 300–500 ft from coordinates)	Grab	Sediment Surface	Est. -35 ft
	B					
	C					
	D					
	E					
Site Water						
MOTMA17-SITE WATER	--	2317434	95128	Pump or bottle	Collected 1 m above bottom	NA

Project elevation includes 2 feet of allowable overdepth.

Station locations will be established using a GPS receiver with an accuracy of 10 meters or less.

10.4.2 Testing Protocol

Table 10-3 shows a summary of the testing protocols for each subsample and composite. Table 10-4 provides greater detail about the specific analyses that will be performed for each sample. The individual parameters for each analytical group, along with methodology and laboratory reporting, limits are provided in Section 13.3.

Table 10-3. Testing and Analysis Requirements for Each Composite

Testing Requirements						
Subsample		**Grain Size for Subsamples**	**Physical Composite**	**Chemical Composite**	**Toxicology Composite**	**Bioaccumulation Composite**
MOTMA17-N	A	Y	Y	Y	Y	Y
	B	Y				
	C	Y				
	D	Y				
	E	Y				
MOTMA17-C	A	Y	Y	Y	Y	Y
	B	Y				
	C	Y				
	D	Y				
	E	Y				
MOTMA17-S	A	Y	Y	Y	Y	Y
	B	Y				
	C	Y				
	D	Y				
	E	Y				
MOTMA17-REFERENCE	A	Y	Y	Y	Y	Y
	B	Y				
	C	Y				
	D	Y				
	E	Y				
MOTMA17-SITE WATER	--	NA	NA	For elutriate and background chemistry	For elutriate and background chemistry	NA

Table 10-4. Analytical Requirements per Project Sample

Sample: Test		MOTMA17-N, MOTMA17-C, MOTMA17-S	MOTMA17-REFERENCE	MOTMA17-SITEWATER	Pretest Tissues
Physicals	Grain Size *	Y	Y	--	--
	Total Solids	Y	Y	--	--
	Specific Gravity	Y	Y	--	--
	Atterberg Limits	Y	Y	--	--
	TOC	Y	Y	--	--
Sediment Chemistry	Metals	Y	Y	--	--
	Organotins	Y	Y	--	--
	Ammonia	Y	Y	--	--
	TPH	Y	Y	--	--
	Pesticides	Y	Y	--	--
	PCB Congeners	Y	Y	--	--
	PCB Aroclors	Y	Y	--	--
	PAHs	Y	Y	--	--
	Dioxins	Y	Y	--	--
Elutriate/Water Chemistry	Metals	Y	--	Y	--
	Ammonia	Y	--	Y	--
	Pesticides	Y	--	Y	--
	PAHs	Y	--	Y	--
Tissue Chemistry*	Metals	TBD	TBD	--	TBD
	Organotins	TBD	TBD	--	TBD
	Pesticides	TBD	TBD	--	TBD
	PCB Aroclors	TBD	TBD	--	TBD
	PCB Congeners	TBD	TBD	--	TBD
	PAHs	TBD	TBD	--	TBD
	Dioxins	TBD	TBD	--	TBD
	Moisture Content	Y	Y	--	Y
	% Lipids	--	--	--	Y
Toxicology	Suspended Phase Bioassay	Y	--	Y	--
	Solid Phase Bioassay	Y	Y	--	--
	Bioaccumulation Potential	Y	Y	--	--

Y = analysis will be performed

-- = analysis will not be performed, is not required, or is not applicable

TBD = Parameters for tissue analysis for all samples will be determined based on review of the sediment chemistry results. Not all samples will be tested for all analytes. Sample zones may be composited.

*Subsamples for each of the composite sediment samples will also be analyzed for grain size.

10.4.3 Reference Station

The selected reference station is in the Atlantic Ocean and corresponds to the RS-NW-D for the New Wilmington ODMDS. This area was chosen for reference material for this project because it is expected to produce sediment of similar grain size distribution as that of the project samples. The reference site is offshore of the Cape Fear River entrance in about 35 feet of water and will be a composite of sediment from a minimum of five stations; one set of coordinates will be provided and all subsamples will be collected from the immediate area. All stations will be in a roughly circular pattern spaced evenly at roughly 300 to 500 feet from the center coordinates.

In accordance with national and regional guidance documents, a reference station is tested and used for comparing bioaccumulation tissue results to that of project area samples when material is proposed for disposal in an ODMDS.

10.5 Classification of Measurements as Critical or Noncritical

Table 10-5 shows all expected measurements that will be made during the course of sampling and laboratory analysis. Each indicates whether it is critical or non-critical for the evaluation of the sediment proposed for disposal in the ODMDS.

Table 10-5. Classification of Measurements as Critical or Noncritical

Measurement	Use	Classification
Sample location using GPS coordinates and accurate depth readings	Used to ensure that the collected sample is within the designated dredging prism.	Critical
In situ measurements	Provide a summary of sampling conditions, including weather, tides, and water quality at the time of sample collection.	Noncritical
Physical analysis	Provides physical characteristics of the sample collected, including grain size, specific gravity, and Atterberg Limits.	Critical
Sediment chemistry	Used for screening to determine the recommended tissue chemistry contaminants of concern and may help determine if the sediment testing results are different from previous studies.	Noncritical
Elutriate chemistry	Used to simulate dredged material disposal and determine if any sediment will exceed the federal water quality criteria.	Critical
Water column toxicology test	Used to simulate the acute effects of the dredge material on aquatic organisms over a short time period.	Critical
Benthic toxicology test	Used to determine the effects of the dredge material on aquatic organisms living in or near the ocean/ sediment interface over a medium- to long-term period.	Critical
Bioaccumulation toxicology test	Used to assess bioaccumulation of contaminants of concern within test organisms. Statistics related to the survival of the organisms shall be reported; however, results that are out of acceptance criteria may still be used on a case-by-case basis, depending on the nature of the failure and total mass of material available for tissue chemistry analysis.	Critical
Tissue chemistry	Used to determine the level of contaminant that is bioaccumulated over a 28-day period, indicating bioaccumulative effects on the native marine species population.	Critical

10.6 Validation of Any Nonstandard Methods

No modifications to any analytical methods are expected in this project. Any modification must be coordinated and approved by USACE before it is implemented.

A discussion of various factors that may affect the toxicological testing is presented in Section 13.3.2, along with proposed corrective actions.

11.0 ELEMENT B2 – SAMPLING AND METHODS REQUIREMENTS

Element B2 encompasses the information indicated in Sections 11.1 through 11.4 below.

11.1 Describe the Sample Collection, Preparation, and Decontamination Procedures

11.1.1 Field Sampling Schedule

The duration of the sampling event is expected to be 2-3 days, depending on several factors, including but not limited to weather conditions, equipment, and accessibility. Redundant systems will be in place to limit down-time due to equipment failure (see Section 11.3, Corrective Action). Security personnel at MOTSU will be contacted prior to field mobilization, and all requirements for access to the facilities will be coordinated by ANAMAR field personnel. Contact information for all parties involved as well as local facilities and security will be distributed to all parties and will be on-hand in the field.

11.1.2 Field and Sampling Procedures

General field methodologies and procedures follow those outlined in the Green Book (USACE/EPA 1991) and the SERIM (USACE/EPA 2008) and in procedures documented in the Florida Department of Environmental Protection Standard Operating Procedures for Field Activities (DEP-SOP-001/01) in Attachment 2. Although the project will be performed in North Carolina, the Florida sample collection standard operating procedures (SOPs) provide scientifically sound methods for equipment decontamination, instrument calibration, and sample handling. A copy of these publications will be on hand for reference during field activities.

Samples will be taken to characterize sediments dredged during the maintenance of the MOTSU harbor. Sampling will include a consideration of the dredging depth, which includes required project depth and any paid allowable overdepth dredging. Grab samples will be collected for all sampling sites for this project. Prior to the sampling trip, the volume of sediment needed will be calculated and enough sample volume will be collected to ensure adequate volume for all analyses and archiving.

11.1.3 Sample Position Accuracy

The station coordinates for the grab sample locations will be entered into a GPS receiver capable of better than 10-meter accuracy, as well as a back-up unit. As described in Section 11.1.5.1, the GPS on the sampling vessel will have an accuracy of less than 1 meter. Coordinates entered all GPS units will be double-checked and mapped prior to field sampling to make sure they are within the correct sampling areas and within channel boundaries. Using the vessel's GPS, the captain will navigate as closely as possible to the target sampling location (typically within 10 meters of the target), and the location will be confirmed with the second GPS unit. GPS coordinates will be collected each time the sampler is deployed. For any sample collected that is not within 50 feet (approximately 15 meters) of the target sample location, the contractor must provide a valid justification for the deviation (i.e., rough seas, strong currents, unable to sample at target location) or reject and discard the sample. The points will be plotted on a map and provided in the report to document accuracy of target sampling stations. The depth at all stations will be recorded using a lead line and a fathometer affixed to the vessel.

All sediment samples will be collected within the DU boundary as close as possible to the proposed sampling location. If the total volume required cannot be collected at a particular station, the contractor will relocate to a site as close as possible to the initial sampling location. If a

suitable location cannot be found within the DU, the field team leader will contact USACE to determine the appropriate corrective action.

The water depth at all stations will be recorded using a lead line and/or a fathometer affixed to the vessel. A lead line is the preferred method to measure water depth; however, strong currents or rough seas can prevent an accurate reading. Therefore, the fathometer will be used as a backup method. To ensure vertical accuracy at each site, water depths will be corrected to MLLW using real-time updated tides from NOAA or the predicted tides from the nearest tide station for this project, which is at the Sunny Point Army Base, Wharf 3 (Station ID 8658579). Tide prediction tables for the period of sampling will be included with the field paperwork when sampling has been scheduled, and may be provided to EPA upon request. In addition, information on the latest available bathymetric surveys will be on board each sampling vessel and will be used as a reference in the field to confirm depths.

11.1.4 Sampling Field Parameters

Site conditions such as prevailing weather, wind direction, air temperature, and tidal cycle will be documented at each sampling site. Water depth, date and time, coordinates, current conditions, sediment descriptions, number of containers, and team member names will be recorded on project-specific field sheets. When collecting the site water sample, in situ hydrographic measurements for water temperature, pH, water depth, dissolved oxygen, salinity, and conductivity will be collected 1 meter below the surface, at mid-depth, and 1 meter above the water/sediment interface using a multi-probe datasonde. Turbidity will be measured using a portable turbidimeter at the surface only. Instrument calibrations will be verified at the beginning and end of the sampling day according to the manufacturers' specifications. Examples of field sheets are provided in Attachment 3.

11.1.5 Sediment Sampling

Grab samples only will be collected for this project. The procedures to be followed are described in the section below.

11.1.6 Sediment Grab Sampling

Grab samples will be collected for all sites and the reference sample using a stainless steel, custom-made grab sampler, van Veen, or Ponar dredge. Depending on sampling conditions and sea state, the Ponar dredge, van Veen, or custom-made sampler will be used interchangeably. During calm conditions, the larger sampler is the preferred sampling device. However, in rougher conditions the Ponar may be a better option because it is smaller, lighter, and easier to handle. Regardless of the sampler used, adequate volume will be collected to perform all analytical tests, including re-analysis.

The sampling device will be lowered and raised by an electric winch. The vessel will either be anchored or the captain will hold the vessel in position while one technician operates the winch and another guides the sampling equipment onto the boat. Once the sampler is brought onboard, as much excess water as possible will be removed from the sampler. The sample will then be emptied into a decontaminated stainless steel bin. If excess water remains in the bin, it will be decanted using a stainless steel pot/spoon while trying to minimize the loss of fines.

Only sediments that are properly collected will be used for testing. Acceptability of grab samples will be determined by noting that the sampler was closed when retrieved and did not appear to have lost surficial fines. Specifically related to the reference sample, an acceptable sample for

this project would be one that is representative of reference station material as indicated in Appendix K of the SERIM. If unrepresentative material is encountered, the contractor will contact the USACE project manager to discuss whether the material is acceptable or if the station should be moved to another location. Consecutive attempts should be made as close to the original location as possible.

When the required volume of sediment has been collected at each sample station, a picture of the sample will be taken and notes on the sample's appearance and characteristics will be recorded on the field sheet. Using decontaminated stainless steel utensils and new disposable gloves, the technician will transfer the sample into pre-cleaned 5-gallon Teflon® bags or 1-gallon clear glass containers with Teflon®-lined lids. All containers will be properly labeled and immediately placed on ice in coolers. Upon return to the boat dock, the samples will be transferred to and locked in a refrigerated vehicle or trailer.

11.1.7 Field Split

A field split will not be analyzed for this project. All quality control will come from laboratory duplicates and spikes.

11.1.8 Water Sampling

One site water sample will be collected for this project. MOTMA17-SITEWATER will be collected from the MOTMA17-C DU and used for elutriate preparation of all project samples.

Site water will be collected at approximately 1 meter above the bottom. All water samples will be collected with a decontaminated stainless steel and Teflon® pump and Teflon®-lined tubing. Water for generating elutriates will be collected into 5-gallon Teflon®-lined cubitainers. Water for bioaccumulation assays will be collected into pre-cleaned 5-gallon cubitainers. Water for background chemistry will be collected into sample containers provided by the laboratory. In addition, hydrographic measurements for water temperature, pH, water depth, dissolved oxygen, salinity, and conductivity will be collected at 1 meter below the surface, mid-depth, and 1 meter above the bottom. Turbidity will be tested for water collected at 1 meter below the surface only. Approximately 40 gallons of site water will be collected to provide adequate volume to prepare sample elutriates for chemistry and toxicology and to have sufficient archive volume available in the event any test needs to be rerun.

Dilution water for toxicological analyses will be collected from Hood Canal in Port Gamble, Washington, which is the physical location of the toxicological laboratory.

11.1.9 Decontamination Procedures

All equipment contacting sediment or water samples will be cleaned and decontaminated as found in FDEP SOP, FC1131 (FDEP 2004) and described below. Work surfaces on the sampling vessel will be cleaned before the sampling day begins and before leaving each station. All equipment contacting sediment or water samples, gloves, and any protective clothing will be changed and/or cleaned between sampling stations to prevent cross-contamination.

Decontamination Procedures

- Wash and scrub using site water or tap water to remove gross contamination
- Wash/scrub with Liquinox®
- Rinse with site water
- Rinse with DI water
- Rinse with pesticide grade (or equivalent) Isopropanol
- Rinse with hexane (required for dioxin analysis, not in FDEP SOP FC1131)
- Rinse with DI water
- Air dry

Any derived waste will be contained and disposed of in accordance with federal, state, and local laws.

11.1.10 Sample Storage and Transport

After collection, the samples will be immediately placed in pre-labeled containers, put in coolers, and packed with ice. Coolers will remain locked inside a field vehicle or in a refrigerated truck or trailer. If the samples are stored in an unrefrigerated vehicle, they will be packed with ice. The ice will be checked at least twice each day and will be refreshed to maintain a temperature of <4˚C. If a refrigerated truck or trailer is used, the inside temperature will be kept at <4˚C and recorded twice daily, morning and evening. If the temperature in the vehicle is above 4°C for one reading, the refrigerator unit will be checked for proper setting and operation and corrected as necessary. Wet ice will be used in addition to the refrigeration if the following conditions are determined:

- The reading is slightly above 4˚C (up to 6˚C) for two consecutive readings
- Any single reading is at or above 8˚C while the refrigeration unit is not in a defrost cycle or refrigeration unit is not cooling after having the truck door open when transferring samples.
- The refrigerated truck is obviously malfunctioning (compressor not working, loud grinding noises, etc.)

Note that the refrigerated truck will enter a defrost cycle that will cause the temperature inside the truck to rise as high as 10°C to 12˚C for up to 30 minutes. This is considered normal operation and will be recorded on the temperature logs. This will not necessitate the use of ice since temperatures are expected to return to normal range shortly thereafter. The collected sediment will be stored in standard insulated coolers and should not be affected by short-term temperature rises to this level.

11.1.11 Sample Handling Prior to Shipment to Laboratories

All samples will continue to be maintained as described above in sample storage and transport.

11.1.12 Sample Homogenization

As the sample is brought on board the vessel, the contents in sampling device will be emptied into a decontaminated stainless steel bin. The sediment will be visually assessed and the physical characteristics will be recorded on project-specific field sheets. The sample will be photographed prior to homogenization, which will occur either in the field or at ANAMAR's office in Gainesville, Florida. Each subsample will be homogenized thoroughly using either a stainless-steel mixer a rotary bit attached to a drill or stainless steel utensils, based on the consistency of the sediment. To ensure adequate homogenization, material from each section of the bin will be distributed to other areas. Large pieces of consolidated material will be broken up as much as possible using the spoons and will be distributed within the sample. This process will continue until the material is as visually consistent as possible, given the physical characteristics of the sediment. Once homogenized, a portion of the homogenized sample will be separated for physical analysis. The remainder will be stored in Teflon® bags for compositing.

11.1.13 Sample Compositing

Samples will be composited at ANAMAR's office in Gainesville, Florida, according to the compositing scheme shown in Table 10-3. The subsamples will be thoroughly mixed into a final composite sample using stainless steel mixers that have been decontaminated prior to use. The composite sample will be divided for physical, chemical, and toxicological analyses, and for generation of elutriates. When the samples are composited, the subsample IDs will no longer be appropriate and new chain-of-custody forms will be filled out and accompany the samples to the laboratories. The composite sample will be fractioned into the containers listed in Table 11-1, placed upon wet ice, and shipped to the laboratories for analysis. A composite log will be filled out to document the process.

Table 11-1. Container Requirements for Sediment Samples for Chemical, Physical, and Toxicological Analyses

MATRIX - SEDIMENT		
Parameter	**Container Type and Size**	
Physical Analysis	Plastic bags	1-gal
TOC	Teflon® bags	5-gal
Metals		
Organics		
Elutriate Prep Sediment		
Toxicological Analysis	Food-grade plastic bags	5-gal

11.1.14 Sample Elutriation

Sample elutriates for chemical analysis will be prepared at ALS Environmental (Section 13.3). Sample elutriates for water column toxicology will be prepared at the toxicology laboratory (EcoAnalysts) (Section 13.3.2). All elutriates will be prepared from homogenized composited sediments and site water and will be generated using methods described in the ITM (USEPA/USACE 1998).

11.2 Identify Support Facilities for Sampling Methods

Table 11-2 shows a list of equipment and consumables that will be used during field sampling.

Table 11-2. List of Sampling Equipment and Support Facilities

Equipment Identification	Use
YSI or other manufacturer multi-probe meter	In situ measurement – Meter for measuring dissolved oxygen, pH, salinity, temperature, and conductivity
Hach 2100P Turbidimeter	Meter for measuring in situ turbidity
Custom-made grab sampler	8.8-gallon and 5.8-gallon stainless steel grab samplers for sediment
van Veen Sampler	4.7-gallon stainless steel grab sampler for sediment
Ponar Sampler	2.2-gallon, stainless steel grab sampler for sediment
Homogenizing/Compositing Bins	ANAMAR - 5-gallon stainless steel chafing dishes, 67-gallon stainless steel bin, 20.8-gallon stainless steel bin, 58.5-gallon stainless steel compositing bin Athena – 45-gallon stainless steel compositing bins
Mixing and Sample Transfer Equipment	Stainless steel spoons, stainless steel pots, stainless steel scrapers, stainless steel mixers (that attach to a drill)
Stainless Steel and Teflon® Water Pump with Teflon® Tubing	Collection of site water for elutriate preparation
Hurricane Water Pump	Back-up water collection
Support Vessel – Athena	This 35-foot pontoon boat (R/V *Artemis*) will be used for all coring stations, grab stations, and site water.
Consumables	Nitrile gloves – General use for any contact with samples pH 4, 7, and 10 standards – Calibration of instrument for in situ measurements 50,000 and 15,000 µMhos conductivity standards – Calibration of instrument for in situ measurements DI water – Decontamination of all equipment used Pesticide-grade or equivalent isopropyl alcohol – Decontamination of all equipment used Teflon® bags – for containerizing samples that are being analyzed for contaminants of concern “Mud bags” – Teflon® bags are placed inside a mud bag Ziploc bags – for containerizing physical samples Duct tape – for closing/securing sample containers Custody tape – for placing on sample coolers being shipped to labs Sample labels – for identifying samples

Table 11-2. List of Sampling Equipment and Support Facilities

Equipment Identification	Use
Safety Equipment	Hardhats and life vests will be worn at all times by all personnel aboard the sampling vessel
Support Vehicle – refrigerated truck	ANAMAR will rent a refrigerated truck to provide on-site storage of samples at the correct temperature until samples are shipped. If a refrigerated truck cannot be rented, ANAMAR will ice samples twice daily as needed to provide appropriate thermal preservation
Support Vehicle – refrigerated trailer	ANAMAR may use their refrigerated trailer if it is deemed necessary, either in conjunction with or instead of a refrigerated truck. If samples are stored in this trailer, the correct temperature will be maintained while samples remain in this unit.
Support Vessel – ANAMAR survey vessel	24-foot Grady White (S/V *ANAMAR*) – This vessel will be available as a backup for all grab sampling stations (including reference station) and site water collection.

Standard operating procedures for the field sampling equipment, including the grab samplers and field meters, are shown in Table 11-3. Attachment 2 contains an electronic version of the referenced standard operating procedures.

Table 11-3. Standard Operating Procedures Used during Sampling

Standard Operating Procedure	Description	Sections Referenced
FD1000	Documentation Procedures	Sections FD1100, FD1200, FD2000, FD3000, FD4000, FD4100, FD5000, FD5100, FD5200
FC1000	Cleaning/Decontamination Procedure	The applicable information from this SOP is in Section 11.1 of this QAPP.
FT1100	Field Measurement of Hydrogen Ion Activity (pH)	Sections 1 – 4
FT1200	Field Measurement of Specific Conductance (Conductivity)	Sections 1 – 5
FT1300	Field Measurement of Salinity	Sections 1 – 5
FT1400	Field Measurement of Temperature	Sections 1 – 4
FT1500	Field Measurement of Dissolved Oxygen	Sections 1 – 4
FT1600	Field Measurement of Turbidity	Sections 1 – 5
ANAMAR Field SOP	Provides protocols for collecting sediment for grab sampling	All sections
ANAMAR Dredge or Grab Samplers as shown in Table 11-3	Procedures for collecting sediment using any of ANAMAR's grab samplers	All sections

11.3 Describe Sampling/Measurement System Failure Response and Corrective Action Process

Any event that does not conform to the QAPP, SOPs, or SAP is considered a nonconformance event. These will be identified as quickly as possible and reported to the project manager as soon as practical. If the nonconformance event happens in the fieldwork portion of this project, it will be documented in the DQCR. The project director and/or project manager will confer with USACE-Wilmington and outline a procedure for accomplishing the task so the quality of the project is not compromised. Every effort will be made to contact the USACE representative prior to any deviation from the above-mentioned procedures.

Backups of field equipment and supplies will be on hand in case of equipment failure or other factors that render the primary method unusable. Examples of backups that will be taken include: Ponar sampler, sample containers, in situ multi-parameter meter, turbidimeter, water sampling pump, etc.

11.4 Sampling Equipment, Sample Preservation, and Holding Times

A list of all field sampling equipment is shown in Table 11-2. Tables 11-4, 11-5, and 11-6 show the sample preservation and analytical holding times for sediments, elutriates and site waters, and tissues. Table 11-6 and 11-7 also show the container type and size that will be used during this project.

Any sampling device or material coming into contact with a sample will be made of an approved material (Teflon®, polycarbonate [Lexan®], or stainless steel) and decontaminated as described in this SOW. Water will be collected with a non-contaminating pump. Grab samples will be taken with a custom-made Petersen-style, van Veen, or Ponar type clamshell sampler. All samples will be placed in appropriate pre-cleaned containers and put in coolers on wet ice immediately after collection. All holding times and preservation methods will conform to USEPA guidelines in QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations (USEPA 1995).

Table 11-4. Analytical Holding Time Requirements for Sediment Physical, Chemical, and Toxicological Analysis

MATRIX: SEDIMENT	
Parameters	**Analytical Holding Time**
Physical Analysis	Not applicable
TOC	14 days
Metals	6 months for all metals except mercury; 28 days for mercury
Organics	14 days for extraction, 40 days after extraction for analysis
Elutriate Prep Sediment	14 days after sediment sample collection
Toxicological Analysis	2 weeks preferred holding time, but no greater than 8 weeks for all toxicological analyses

All analytical parameters in Table 11-5 except physical analysis require thermal preservation to <4˚C.

Table 11-5. Container Requirements, Sample Preservation, and Holding Times for Water and Elutriate Samples for Chemical, Physical, and Toxicological Analysis

MATRIX: WATER (Site Water and Elutriate)				
Parameters	**Container Type and Volume**		**Preservation**	**Holding Time**
Metals	Teflon® or glass	2 gal	Nitric Acid to pH < 2	6 months for all metals except mercury; 14 days for mercury
Organics	Amber glass		Cool to <4˚C	7 days for sample extraction, 40 days after extraction for analysis
Elutriate Prep Water	Teflon®-lined cubitainers	5 gal	Cool to <4˚C	7 days
Toxicological Analysis	Teflon®-lined cubitainers	5 gal	Cool to <4˚C	2 weeks for elutriate preparation, then 24 hours after preparation to begin test

Table 11-6. Container Requirements, Sample Preservation, and Holding Times for Tissue Samples for Chemical Analysis

MATRIX: TISSUE				
Parameters	**Container Type and Size**		**Preservation**	**Holding Time**
Metals, Organics, Lipids	Glass	250 mL	Freeze to <-20˚C in pre-cleaned Teflon® lined glass jars	28 days for mercury 6 months for all metals except mercury 14 days for organics Not determined for lipids

12.0 ELEMENT B3 – SAMPLE HANDLING AND CUSTODY REQUIREMENTS

12.1 Sample Handling

All samples will be handled according to procedures and methods outlined in QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations (USEPA 1995).

All sediment and water containers will be labeled and filled out entirely. The label information will be consistent with that provided on the chain-of-custody form. Sample labels will include the following information:

1. Project
2. Sample Identification number and station number
3. Matrix
4. Date and time of sample collection
5. Name of collector
6. Sample preservation used, if required
7. Lab number or name

Samples will be composited and homogenized as described in Sections 11.1.12 and 11.1.13. Section 11.1 also explains procedures pertaining to sample storage and transport. The forms listed in Table 12-1 are used in the field to document information regarding sample collection and handling and are provided in Attachment 3.

Table 12-1. Field Activity Forms Used to Document Sample Collection and Support Activities

Filename	Purpose
ANAMAR Chain of Custody	Chain-of-custody form for shipping samples from ANAMAR to the laboratories for analysis
Daily Quality Control Report	The Daily Quality Control Report, which provides any deviations from this QAPP, Region 4 guidelines, or any anomalous behavior of the samples. It is to be filled out on a daily basis after sample collection or any other field activities.
Instrument Calibration Sheet	Calibration log for the instruments used for in situ measurements
Sediment and Water Sampling Sheet	Shows the information about each sediment or water sample collected, as well as in situ measurements and site conditions. It also includes a description of the sample as it is brought on board the vessel.
Temperature Log	Daily temperature log for recording sample temperature. Any deviations outside the acceptable limit will necessitate immediate corrective action to bring the samples back within control.
Composite Log	Documents which sub-samples were composited together and approximately how much volume from each sub-sample was included in the composite sample.

12.2 Chain of Custody Requirements

Chains of custody will be initiated at the time samples are prepared for shipment. All chain-of-custody forms will include the sample ID, date and time of sample collection (composite samples will use the earliest date and time among its subsamples), list of analytical groups with reference to a complete list of individual analytes provided as a separate document, number and type of sample containers, and any comments or special instructions to the laboratory for analysis. Each laboratory chain of custody will be signed by both parties during transfer of samples from ANAMAR to the analytical laboratory.

12.3 Sample Shipping and Tracking

Sample shipping from ANAMAR to the laboratories for analysis will use a common courier (e.g., Federal Express). The laboratories will be contacted on the day of shipping to inform them of the shipment, which can then be tracked by computer using the tracking number provided or by phone. Prior to the end of the day the samples are scheduled for delivery, the recipient will be contacted to determine if the samples arrived. If there is any delay, the courier will be contacted to determine the time the samples will be delivered and any additional corrective action that may be necessary in the event of unexpected delays (e.g., weather-related or flight cancellations). Should the delay cause the samples to rise above the acceptable temperature for storage, USACE and EPA will be contacted and corrective actions will be determined.

All coolers will have custody tape attached prior to shipment. Once received, each custody seal will be inspected to determine if it is intact and that information will be recorded on the chain-of-custody form. If the custody seal is not received intact, USACE and EPA will be contacted to determine if corrective action is required.

12.4 Intra- and Inter-Laboratory Tracking

Upon receipt at the laboratories, the samples will be logged into the laboratory computerized information management system and assigned a unique number for tracking through the analytical process in the lab. Any sample aliquot, tissue sample being transferred from the toxicology lab to the chemistry lab, or any other lab transfer of any sample (sediment, water, or tissue) will have complete chain-of-custody records. All chain-of-custody records will be included in the final report to USACE.

12.5 Storage and Disposal of Samples

The laboratories will retain all remaining unused sample volume under appropriate temperature and light conditions at least until the data generated from the samples go through ANAMAR QA/QC and are approved as acceptable. Preferably, samples will be retained until the final report is submitted to USACE. The storage/archive time will be dependent on space available at the laboratory. Approval by the USACE project manager will be obtained prior to disposal of any sediment, water, or tissue sample if disposal is needed before the final report is submitted. Samples will be disposed of properly according to federal, state, and local laws.

13.0 ELEMENT B4 – ANALYTICAL METHODS REQUIREMENTS

Element B4 encompasses the information indicated in Sections 13.1 through 13.3, below.

13.1 Subsampling

Tables 10-2 through 10-4 shows the individual subsamples for this project, the overall compositing scheme, and the analytical requirements for each subsample.

13.2 Preparation of the Samples

Physical and Chemical Analysis of Sediment, Elutriates, and Tissues

In accordance with all applicable regulatory and guidance documents, physical, chemical, and toxicological testing will be conducted on the sediment as stated in Section 10. Analytical procedures will be performed on the composited sediment samples. Grain size analysis will also be performed on the homogenized subsamples. Physical and chemical analysis will be conducted on samples as indicated in Table 10-3. Adequate sample volume will be collected to allow sufficient material to be analyzed to account for high water content in the sediment samples and dilution of samples when addressing detection limits and interferences (Table 13-1). Sediment samples will be obtained from an estuarine environment. The contract laboratory will use applicable measures to control salt interference. Composite samples from a particular location will be completely homogenized prior to obtaining splits for the required analyses. For all sediment analyses, the concentration, laboratory reporting limit (LRL), and method detection limit (MDL) will be reported on a dry weight basis; tissues will be reported on both wet and dry weight bases. All analyses shall be performed in a timely manner, allowing for retesting prior to expiration of holding times. If alternative methods or detection limits are used, approval from USACE and EPA Region 4 is required.

Table 13-1. Minimum Volume Requirements per Sample for Physical, Chemical, and Toxicological Analysis of Sediment, Elutriate, Site Water, and Tissue Samples

Analytical Group	Sediment per Sample	Site Water per Sample (gallons)	Tissue (g wet weight)
Metals	4 oz	2	20
Organics	32 oz		50
TOC	4 oz	NA	NA
Elutriate Prep	2 gal [1]	3-5 [1]	NA
Physical Analysis	½ - 1 gal	NA	NA
Toxicology	20-25 gal	3 [2]	NA
Total Volume per Sample	30-35 gal	8-10	70

[1] An additional 2.5 gallons of sediment and 5 gallons of site water will be needed for project QC.

[2] Used for dilution water

Elutriates will be generated by ALS in Kelso, Washington, using the methods described in Section 10.1.2.1 of the Green Book, equivalent to Section 10.1.2.1 of the ITM (EPA and USACE 1998).

For chemical analysis of elutriates, ALS uses a reductive precipitation procedure to reduce interferences from salts for metals analysis. Organic compounds are not affected by salt interferences.

All analyses shall be performed in a timely manner, allowing for retesting prior to expiration of holding times. If alternative methods or detection limits are used, approval from USACE and EPA Region 4 is required.

For grain size distributions, in addition to reporting the percentages in each size class, a graph of the cumulative frequency percentages using U.S. Army Engineering (ENG) Form 2087 (Gradation Curves) or similar form will be used.

13.3 Analytical Methods

13.3.1 Physical and Chemical Analysis

Tables 13-2 through 13-5 show the analytical parameters that will be tested in the project samples, along with preparation and analytical methodology, the target detection limits from the SERIM, and the laboratory reporting limits. The LRL shown in Tables 13-3 through 13-5 may vary due to total solids content. Additionally, matrix interferences can cause the LRL to be elevated. Refer to Section 14.1.2.1 for a discussion of matrix interferences and their effects on sample analyses.

Table 13-2. Analytes, Methods, and Target Measurement/Quantitation Limit: Sediment Physical Analyses

Parameter	Test Method	Target Measurement/ Quantitation Limit
Grain Size	ASTM-D422	0.1 %
Total Solids/Water Content	ASTM-D2216-80	1.0 % solids
Specific Gravity of soils	ASTM D-854-00	NA
Atterberg Limits	ASTM 4318D	NA

Table 13-3. Analytes, Methods, Target Detection Limits and Laboratory Reporting Limits: Sediment Chemistry (applicable to all composite sediment samples)

Test Parameters	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1] (Dry Weights)	SOW Reporting Limits (Dry Weights)	ALS Laboratory Reporting Limit (Dry Weights)
METALS					
Antimony	3050B	6010b/200.8/ 6020A	NA	0.50 mg/kg	0.050 mg/kg
Arsenic	3050B		1 mg/kg	0.10 mg/kg	*0.50 mg/kg*
Beryllium	3050B		NA	0.50 mg/kg	0.20 mg/kg
Cadmium	3050B		0.1 mg/kg	0.10 mg/kg	0.020 mg/kg
Chromium	3050B		1 mg/kg	0.10 mg/kg	*0.20 mg/kg*
Copper	3050B		1 mg/kg	0.10 mg/kg	0.10 mg/kg
Lead	3050B		0.5 mg/kg	0.10 mg/kg	0.050 mg/kg
Mercury	7471A	7471A	0.05 mg/kg	0.05 mg/kg	0.020 mg/kg

Table 13-3. Analytes, Methods, Target Detection Limits and Laboratory Reporting Limits: Sediment Chemistry (applicable to all composite sediment samples)

Test Parameters	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1] (Dry Weights)	SOW Reporting Limits (Dry Weights)	ALS Laboratory Reporting Limit (Dry Weights)
Nickel	3050B	6010b/200.8/ 6020A	1 mg/kg	0.10 mg/kg	*0.20 mg/kg*
Selenium	3050B		1 mg/kg	0.20 mg/kg	0.10 mg/kg
Silver	3050B		0.2 mg/kg	0.062 mg/kg	0.020 mg/kg
Thallium	3050B		NA	1.00 mg/kg	0.020 mg/kg
Zinc	3050B		1 mg/kg	0.50 mg/kg	0.50 mg/kg
PESTICIDES					
Aldrin	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Chlordane & deriv.					
Tech. Chlordane	3541	8081B LL	10 µg/kg	1.7 µg/kg	**10 µg/kg**
α (cis)–Chlordane	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
γ (trans)–Chlordane	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Oxychlordane	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Cis-Nonachlor	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Trans-Nonachlor	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
DDT & derivatives					
o,p' (2,4')-DDD	3541	8081B LL	NA	1.7 µg/kg	1 µg/kg
p,p' (4,4')-DDD	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
o,p' (2,4')-DDE	3541	8081B LL	NA	1.7 µg/kg	1 µg/kg
p,p' (4,4')-DDE	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
o,p' (2,4')-DDT	3541	8081B LL	NA	1.7 µg/kg	1 µg/kg
p,p' (4,4')-DDT	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Dieldrin	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Endosulfan & derivs					
Endosulfan I	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Endosulfan II	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Endrin & derivatives					
Endrin	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Endrin aldehyde	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Endrin ketone	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Heptachlor and derivs					
Heptachlor	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Heptachlor epoxide	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Hexachlorocyclohexane (BHC)					
α-BHC	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
β-BHC	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
δ-BHC	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
γ-BHC (Lindane)	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Methoxychlor	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Mirex©	3541	8081B LL	10 µg/kg	1.7 µg/kg	1 µg/kg
Toxaphene	3541	8081B LL	50 µg/kg	167 µg/kg	50 µg/kg
Total Chlorinated Pest.	3541	8081B LL	NA	10 µg/kg	10 µg/kg

Table 13-3. Analytes, Methods, Target Detection Limits and Laboratory Reporting Limits: Sediment Chemistry (applicable to all composite sediment samples)

Test Parameters	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1] (Dry Weights)	SOW Reporting Limits (Dry Weights)	ALS Laboratory Reporting Limit (Dry Weights)
PCB CONGENERS					
PCB-8	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-18	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-28	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-44	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-49	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-52	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-66	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-77	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-87	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-101	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-105	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-118	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-126	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-128	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-138	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-153	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-156	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-169	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-170	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-180	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-183	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-184	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-187	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-195	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-206	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB-209	3541	Mod 8082A	1.0 µg/kg	1 µg/kg	0.5 µg/kg
PCB AROCLORS					
PCB-1016	3541	8082A	NA	33 µg/kg	10 µg/kg
PCB-1221	3541	8082A	NA	33 µg/kg	20 µg/kg
PCB-1232	3541	8082A	NA	33 µg/kg	10 µg/kg
PCB-1242	3541	8082A	NA	33 µg/kg	10 µg/kg
PCB-1248	3541	8082A	NA	33 µg/kg	10 µg/kg
PCB-1254	3541	8082A	NA	33 µg/kg	10 µg/kg
PCB-1260	3541	8082A	NA	33 µg/kg	10 µg/kg
POLYNUCLEAR AROMATIC HYDROCARBONS					
1-Methylnaphthalene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
2-Methylnaphthalene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Acenaphthene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Acenaphthylene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Anthracene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Benz(a)anthracene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Benzo(a)pyrene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg

Table 13-3. Analytes, Methods, Target Detection Limits and Laboratory Reporting Limits: Sediment Chemistry (applicable to all composite sediment samples)

Test Parameters	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1] (Dry Weights)	SOW Reporting Limits (Dry Weights)	ALS Laboratory Reporting Limit (Dry Weights)
Benzo(b)fluoranthene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Benzo(g,h,i)perylene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Benzo(k)fluoranthene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Chrysene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Dibenz(a,h)anthracene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Fluoranthene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Fluorene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Indeno(1,2,3-cd)pyrene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Naphthalene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Phenanthrene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Pyrene	3541	8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
DIOXINS					
All congeners	Method	8290	NA	1.0 ng/kg (2,3,7,8 TCDD)	*0.5-5.0 ng/kg*
ORGANOTINS					
Mono-butyltin	Method	Krone	10 µg/kg	1.0 µg/kg	1 µg/kg
Di-butyltin	Method	Krone	10 µg/kg	1.3 µg/kg	1 µg/kg
Tri-butyltin	Method	Krone	10 µg/kg	1.5 µg/kg	1 µg/kg
MISCELLANEOUS ANALYTES					
Total Organic Carbon	Method	9060 Mod	0.1%	100 mg/kg	0.05%
Ammonia	Method	SM 4500 NH3 E Mod	NA	0.5 mg/kg	0.5 mg/kg
Total Petroleum Hydrocarbons (also referred to as TPH or Oil and Grease)	Method	EPA 1664/9071B	NA	0.25 mg/kg	100 mg/kg

[1]Source: SERIM Tables 5-3 through 5-7

Notes regarding the sediment methods and reporting limits

The specified methods are recommendations only. Any method that can achieve these target detection limits (TDLs) is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

Several methods shown above have a letter following the method number, e.g. 8082B. The letter indicates the EPA revision for the specific method. Based on NELAC guidance, the laboratory should use the most recent method, and the specific revision is implied if it is not present.

Italicized Text - The test methods for the following analytes have laboratory reporting limits greater than the target reporting limits specified in the SOW, but have method detection limits which meet the SOW: arsenic, chromium, nickel, and dioxins. Both the laboratory reporting limit and method detection limits will be provided as part of the final report. These lab reporting limits are identified in italicized text in the table above.

Bold Text - Due to limitations with the analytical procedure, neither the laboratory reporting limit nor the method detection limit for chlordane meet the SOW reporting limit. These reporting limits are identified in bold text in the table above.

A brief discussion of method detection limits and reporting limits is provided in Section 14.3.1.1.

Table 13-4. Analytes, Methods, Target Reporting Limits, and Laboratory Reporting Limits: Elutriate and Site Water Chemistry

Test Parameters	Preparation Method	Recommended Test Method	SERIM Target Detection Limit[1]	SOW Reporting Limits	ALS Laboratory Reporting Limit
Ammonia	Method	350.1	30.0 µg/L	30.0 µg/L	*50.0 µg/L*
METALS					
Antimony	CLP/20 x dilution	200.8/6020/ 6010B	NA	1.0 µg/L	1.0 µg/L
Arsenic	Red Ppt./1640M		1 µg/L	1.0 µg/L	0.5 µg/L
Beryllium	Red Ppt./1640M		NA	1.0 µg/L	1.0 µg/L
Cadmium	Red Ppt./1640M		1 µg/L	1.0 µg/L	1.0 µg/L
Chromium	Red Ppt./1640M		1 µg/L	1.0 µg/L	0.2 µg/L
Copper	Red Ppt./1640M		1 µg/L	1.0 µg/L	0.1 µg/L
Lead	Red Ppt./1640M		1 µg/L	1.0 µg/L	0.04 µg/L
Mercury	Red Ppt./1640M	245.1 or 7470	0.2 µg/L	0.2 µg/L	0.2 µg/L
Nickel	Red Ppt./1640M	200.8/6020/ 6010B	1 µg/L	1.0 µg/L	0.2 µg/L
Selenium	3010A	200.8/6020/7742	2 µg/L	2.0 µg/L	1.0 ug/L
Silver	Red Ppt./1640M	200.8/6020/ 6010B	1 µg/L	1.0 µg/L	0.02 µg/L
Thallium	Red Ppt./1640M		NA	1.0 µg/L	0.02 µg/L
Zinc	Red Ppt./1640M		1 µg/L	1.0 µg/L	*2 µg/L*
PESTICIDES					
Aldrin	3541	8081A	0.5 µg/L	0.5 µg/L	0.01 µg/L
Chlordane & derivs.					
Chlordane	3541	8081A	0.05 µg/L	0.5 µg/L	*0.2 µg/L*
α (cis)–Chlordane	3541	8081A	NA	0.5 µg/L	0.01 µg/L
γ (trans)–Chlordane	3541	8081A	NA	0.5 µg/L	0.01 µg/L
Oxychlordane	3541	8081A	NA	0.5 µg/L	0.01 µg/L
Cis-Nonachlor	3541	8081A	NA	0.5 µg/L	0.01 µg/L
Trans-Nonachlor	3541	8081A	NA	0.5 µg/L	0.01 µg/L
DDT & derivatives					
o,p' (2,4')-DDD	3541	8081A	NA	0.05 µg/L	0.01 µg/L
p,p' (4,4')-DDD	3541	8081A	NA	0.05 µg/L	0.01 µg/L
o,p' (2,4')-DDE	3541	8081A	NA	0.05 µg/L	0.01 µg/L
p,p' (4,4')-DDE	3541	8081A	NA	0.05 µg/L	0.01 µg/L
o,p' (2,4')-DDT	3541	8081A	NA	0.05 µg/L	0.01 µg/L
p,p' (4,4')-DDT	3541	8081A	0.1 µg/L	0.05 µg/L	0.01 µg/L
Dieldrin	3541	8081A	0.5 µg/L	0.05 µg/L	0.01 µg/L
Endosulfan & derivs.					
Endosulfan I	3541	8081A	0.03 µg/L	0.01 µg/L	0.01 µg/L
Endosulfan II	3541	8081A	0.03 µg/L	0.01 µg/L	0.01 µg/L
Endrin and derivs.					
Endrin	3541	8081A	0.03 µg/L	0.01 µg/L	0.01 µg/L
Endrin aldehyde	3541	8081A	NA	0.01 µg/L	0.01 µg/L
Endrin ketone	3541	8081A	NA	0.01 µg/L	0.01 µg/L
Heptachlor & derivs.					
Heptachlor	3541	8081A	0.05 µg/L	0.01 µg/L	0.01 µg/L
Heptachlor epoxide	3541	8081A	0.05 µg/L	0.01 µg/L	0.01 µg/L
Hexachlorocyclohexane (BHC)		8081A			
α-BHC	3541	8081A	NA	0.01 µg/L	0.01 µg/L
β-BHC	3541	8081A	NA	0.01 µg/L	0.01 µg/L
δ-BHC	3541	8081A	NA	0.01 µg/L	0.01 µg/L

Table 13-4. Analytes, Methods, Target Reporting Limits, and Laboratory Reporting Limits: Elutriate and Site Water Chemistry

Test Parameters	Preparation Method	Recommended Test Method	SERIM Target Detection Limit[1]	SOW Reporting Limits	ALS Laboratory Reporting Limit
γ-BHC (Lindane)	3541	8081A	0.1 µg/L	0.01 µg/L	0.01 µg/L
Methoxychlor	3541	8081A	NA	0.01 µg/L	0.01 µg/L
Mirex	3541	8081A	NA	0.01 µg/L	0.01 µg/L
Toxaphene	3541	8081A	0.2 µg/L	0.2 µg/L	*0.5 µg/L*
PAHs					
1-Methylnaphthalene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
2-Methylnaphthalene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Acenaphthene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Acenaphthylene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Anthracene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Benz(a)anthracene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Benzo(a)pyrene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Benzo(b)fluoranthene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Benzo(g,h,i)perylene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Benzo(k)fluoranthene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Chrysene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Dibenz(a,h)anthracene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Fluoranthene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Fluorene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Indeno(1,2,3-cd) pyrene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Naphthalene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Phenanthrene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L
Pyrene	3520C	8270D SIM	NA	0.005 µg/L	0.0034 µg/L

[1]Source: SERIM Tables 5-9 through 5-11

Notes regarding the elutriate and site water methods and reporting limits

The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

Several methods shown above have a letter following the method number, e.g. 8082B. The letter indicates the EPA revision for the specific method. Based on NELAC guidance, the laboratory should use the most recent method, and the specific revision is implied if it is not present.

A brief discussion of method detection limits and reporting limits is provided in Section 14.3.1.1.

Italicized Text - The following test methods have laboratory reporting limits greater than the target limits specified in the SOW or SERIM, but have method detection limits which meet the SOW: ammonia, chlordane, toxaphene, and PAHs. Both the laboratory reporting limit and method detection limits will be provided as part of the final report. The lab reporting limits are provided in *italicized text* and the MDLs are provided in parentheses.

Since the method report limits (MRLs) for toxaphene and chlordane exceed the water quality criteria, the laboratory's MDL (which has been verified through the analysis of the appropriate MDL check samples) will be used in the calculations if the analyte concentration is below the MRL (per Section 7.3.2 of the SERIM). The MDL for chlordane is 0.020 µg/L and the MDL for toxaphene is 0.05 µg/L. The laboratory's MDL studies for chlordane and toxaphene are available upon request.

Table 13-5. Analytes, Methods, and Target Reporting Limits: Tissue Chemistry

Parameter	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1]	SOW Reporting Limit (wet wt)	ALS Reporting Limit (wet wt)
METALS/OTHERS					
Antimony	PSEP Tissue	6010b/200.8	NA	0.5 mg/kg	0.05 mg/kg
Arsenic			0.2 mg/kg	0.2 mg/kg	*0.5 mg/kg*
Beryllium			NA	0.5 mg/kg	0.1 mg/kg
Cadmium			0.1 mg/kg	0.1 mg/kg	0.1 mg/kg
Chromium			1 mg/kg	0.5 mg/kg	0.4 mg/kg
Copper			1 mg/kg	1 mg/kg	0.4 mg/kg
Lead			0.2 mg/kg	0.2 mg/kg	0.02 mg/kg
Mercury		7471A	0.02 mg/kg	0.02 mg/kg	0.02 mg/kg
Nickel		6010b/200.8	1 mg/kg	1 mg/kg	0.4 mg/kg
Selenium			NA	0.20 mg/kg	0.1 mg/kg
Silver			0.2 mg/kg	0.062 mg/kg	0.02 mg/kg
Thallium			NA	0.01 mg/kg	*0.02 mg/kg*
Zinc			1 mg/kg	1 mg/kg	0.4 mg/kg
% Moisture	NA	EPA 1986, 1987	NA	0.1%	0.1%
Lipids	NA	Lee et al., 1989	NA	0.1%	0.01%
ORGANOTINS					
Monobutyltin	Method	Krone	10 µg/kg	1.0 µg/kg	1 µg/kg
Dibutyltin			10 µg/kg	1.3 µg/kg	1 µg/kg
Tributyltin			10 µg/kg	1.5 µg/kg	1 µg/kg
PESTICIDES					
Aldrin	3541	8081A	2 µg/kg	1.7 µg/kg	1.0 µg/kg
Chlordane & deriv.					
Technical Chlordane			2 µg/kg	1.7 µg/kg	*10 µg/kg*
α *(cis)*–Chlordane			2 µg/kg	1.7 µg/kg	1.0 µg/kg
γ *(trans)*–Chlordane			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Oxychlordane			2 µg/kg	1.7 µg/kg	*2.5 µg/kg*
Cis-Nonachlor			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Trans-Nonachlor			2 µg/kg	1.7 µg/kg	1.0 µg/kg
DDD & derivatives					
o,p' (2,4')-DDD			2 µg/kg	1.7 µg/kg	*2.5 µg/kg*
p,p' (4,4')-DDD			2 µg/kg	1.7 µg/kg	1.0 µg/kg
o,p' (2,4')-DDE			2 µg/kg	1.7 µg/kg	*2.5 µg/kg*
p,p' (4,4')-DDE			2 µg/kg	1.7 µg/kg	1.0 µg/kg
o,p' (2,4')-DDT			2 µg/kg	1.7 µg/kg	1.0 µg/kg
p,p' (4,4')-DDT			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Dieldrin			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Endosulfan & deriv.					
Endosulfan I			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Endosulfan II			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Endrin & derivatives					
Endrin			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Endrin aldehyde			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Endrin ketone			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Heptachlor and deriv.					
Heptachlor			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Heptachlor epoxide			2 µg/kg	1.7 µg/kg	1.0 µg/kg

Table 13-5. Analytes, Methods, and Target Reporting Limits: Tissue Chemistry

Parameter	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1]	SOW Reporting Limit (wet wt)	ALS Reporting Limit (wet wt)
Hexachlorocyclohexane (BHC)					
α-BHC			2 µg/kg	1.7 µg/kg	1.0 µg/kg
β-BHC			2 µg/kg	1.7 µg/kg	1.0 µg/kg
δ-BHC			2 µg/kg	1.7 µg/kg	2.0 µg/kg
γ-BHC (Lindane)			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Methoxychlor			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Mirex ©			2 µg/kg	1.7 µg/kg	1.0 µg/kg
Toxaphene			50 µg/kg	167 µg/kg	50 µg/kg
POLYNUCLEAR AROMATIC HYDROCARBONS					
Acenaphthene	3541	8310/8270 SIM	20 µg/kg	20 µg/kg	5 µg/kg
Acenaphthylene			20 µg/kg	20 µg/kg	5 µg/kg
Anthracene			20 µg/kg	20 µg/kg	5 µg/kg
Benzo(a)fluoranthene			20 µg/kg	20 µg/kg	5 µg/kg
Benzo(b)fluoranthene			20 µg/kg	20 µg/kg	5 µg/kg
Benzo(k)fluoranthene			20 µg/kg	20 µg/kg	5 µg/kg
Benzo(a)pyrene			20 µg/kg	20 µg/kg	5 µg/kg
Benzo(g,h,i)perylene			20 µg/kg	20 µg/kg	5 µg/kg
Chrysene			20 µg/kg	20 µg/kg	5 µg/kg
Dibenzo(a,h)anthracene			20 µg/kg	20 µg/kg	5 µg/kg
Fluorene			20 µg/kg	20 µg/kg	5 µg/kg
Fluoranthene			20 µg/kg	20 µg/kg	5 µg/kg
Indeno(1,2,3-cd)pyrene			20 µg/kg	20 µg/kg	5 µg/kg
1-Methylnaphthalene			20 µg/kg	20 µg/kg	5 µg/kg
2-Methylnaphthalene			20 µg/kg	20 µg/kg	5 µg/kg
Naphthalene			20 µg/kg	20 µg/kg	5 µg/kg
Phenanthrene			20 µg/kg	20 µg/kg	5 µg/kg
Pyrene			20 µg/kg	20 µg/kg	5 µg/kg
DIOXINS					
All congeners	Method	8290	NA	1.0 ppt (2378 TCDD-others slightly higher)	*0.5 – 5 ng/kg*
PCB CONGENERS					
PCB-8	3541	8082A	1.0 µg/kg	N/A	0.5 µg/kg
PCB-18			1.0 µg/kg	N/A	0.5 µg/kg
PCB-28			1.0 µg/kg	N/A	0.5 µg/kg
PCB-44			1.0 µg/kg	N/A	0.5 µg/kg
PCB-49			1.0 µg/kg	N/A	0.5 µg/kg
PCB-52			1.0 µg/kg	N/A	0.5 µg/kg
PCB-66			1.0 µg/kg	N/A	0.5 µg/kg
PCB-77			1.0 µg/kg	N/A	0.5 µg/kg
PCB-87			1.0 µg/kg	N/A	0.5 µg/kg
PCB-101			1.0 µg/kg	N/A	0.5 µg/kg

Table 13-5. Analytes, Methods, and Target Reporting Limits: Tissue Chemistry

Parameter	Prep Method	Recommended Test Method	SERIM Target Detection Limit[1]	SOW Reporting Limit (wet wt)	ALS Reporting Limit (wet wt)
PCB-105			1.0 µg/kg	N/A	0.5 µg/kg
PCB-118			1.0 µg/kg	N/A	0.5 µg/kg
PCB-126			1.0 µg/kg	N/A	0.5 µg/kg
PCB-128			1.0 µg/kg	N/A	0.5 µg/kg
PCB-138			1.0 µg/kg	N/A	0.5 µg/kg
PCB-153			1.0 µg/kg	N/A	0.5 µg/kg
PCB-156			1.0 µg/kg	N/A	0.5 µg/kg
PCB-169			1.0 µg/kg	N/A	0.5 µg/kg
PCB-170			1.0 µg/kg	N/A	0.5 µg/kg
PCB-180			1.0 µg/kg	N/A	0.5 µg/kg
PCB-183			1.0 µg/kg	N/A	0.5 µg/kg
PCB-184			1.0 µg/kg	N/A	0.5 µg/kg
PCB-187			1.0 µg/kg	N/A	0.5 µg/kg
PCB-195			1.0 µg/kg	N/A	0.5 µg/kg
PCB-206			1.0 µg/kg	N/A	0.5 µg/kg
PCB-209			1.0 µg/kg	N/A	0.5 µg/kg
PCB AROCLORS					
PCB-2016	3541	8082A	N/A	N/A	10 µg/kg
PCB-1221			N/A	N/A	10 µg/kg
PCB-1232			N/A	N/A	10 µg/kg
PCB-1242			N/A	N/A	10 µg/kg
PCB-1248			N/A	N/A	10 µg/kg
PCB-1254			N/A	N/A	10 µg/kg
PCB-1260			N/A	N/A	10 µg/kg

[1]Source: SERIM Tables 6-4 through 6-8

Notes regarding the tissue methods and reporting limits

The specified methods are recommendations only. Any method that can achieve these TDLs is acceptable, provided the appropriate documentation of the method performance is generated for the project and the method is adequately identified and described in the SAP/QAPP.

Several methods shown above have a letter following the method number, e.g. 8270D. The letter indicates the EPA revision for the specific method. Based on NELAC guidance, the laboratory should use the most recent method, and the specific revision is implied if it is not present.

Italicized Text - The following test methods have laboratory reporting limits greater than the target limits specified in the SOW, but have method detection limits which meet the SOW: arsenic, thallium, technical chlordane, oxychlordane, 2,4'-DDD, 2,4'-DDE, and dioxins. Both the laboratory reporting limit and method detection limits will be provided as part of the final report. These lab reporting limits are identified in *italicized text* in the table above.

For the analytes with reporting limits greater than the target detection limits from the SERIM, the laboratory's MDL (which has been verified through the analysis of the appropriate MDL check samples) will be used in the calculations if the analyte concentration is below the MRL (per Section 7.5.1 of the SERIM). While the MDL for technical chlordane still exceeds the target detection limit from the SERIM, it is well below the FDA action levels and screening criteria shown in Appendix H of the SERIM.

13.3.2 Biological Analysis

This section summarizes the test methods that will be used to conduct the benthic, water column, and bioaccumulation potential tests. All sediment samples will be evaluated in accordance with procedures recommended in the ITM and the SERIM. This program will include bioassay analysis of composite samples and one reference sample (also a composite). Composite and reference sediments will not be sieved prior to testing. In addition, appropriate laboratory control samples will be analyzed with each of the selected test species. Ammonia concentrations in composite sample pore-water in the bulk sediments will be analyzed prior to bioassay testing. Bioassay testing for this project consists of three water column toxicity tests, two benthic toxicity tests, and two bioaccumulation tests. Tests proposed for this project are summarized in Table 13-6. The preferred holding time for analysis is 2 weeks; however, all tests will be initiated within the maximum 8-week holding time specified in the ITM and the SERIM.

Table 13-6. Bioassay Testing Proposed for Suitability of Dredged Material under SERIM Guidance

Test Type	Type of Organism	Project Sediments	Reference Sediments	Negative Control (Sediment or Seawater)	Positive Control (Reference Toxicant)
Water column	Crustacean	X	Not applicable	X	X
	Fish	X	Not applicable	X	X
	Zooplankton	X	Not applicable	X	X
Benthic	Amphipod	X	X	X	X
	Polychaete	X	X	X	X
Bioaccumulation Potential	Polychaete	X	X	X	X
	Bivalve	X	X	X	X

Water Column Testing

Water-column bioassay tests will be performed to estimate the potential impact of aquatic disposal of dredged material to organisms that live in the water column. The water column test will be performed using a 4:1 dilution by volume of seawater to test dredge material. Sediment from each composite will be combined with dredging-area site seawater in a 4:1 ratio by volume, vigorously agitated for 30 minutes, and then allowed to settle for 1 hour. After 1 hour of settling, the clear supernatant above the sediment will be gently decanted. This supernatant represents the 100% test concentration and is used for serial dilutions with clean seawater (0.45-µm-filtered Hood Canal water) to create subsequent test concentrations for the water-column tests. Three species will be tested: mysid shrimp (*Americamysis bahia*) (formerly *Mysidopsis bahia*), inland silverside fish (*Menidia beryllina*), and an echinoderm or bivalve larvae. The invertebrate species used for larval development testing will be dependent upon natural spawning cycles occurring during the project testing phase. One of the following recommended species will be chosen: eastern oyster (*Crassostrea virginica*), blue mussel (*Mytilus edulis*), or the purple urchin (*Strongylocentrotus purpuratus*), purple spined urchin (Arbacia punctulata), or an alternate Mediterranean mussel (*Mytilus galloprovincialis*) if the recommended species are unavailable. The 100% test elutriate may be centrifuged for 10 minutes prior to dilution preparation to remove fine debris or flocculent material that may interfere with the observations of the larval developmental endpoints.

For the mysid and the fish tests, the sediment elutriate will be tested at 100%, 50%, and 10%, along with a seawater control and the dredging site water. Additional dilutions will be prepared and run if the 10% dilution does not have at least 50% survival. Ten animals will be used per replicate, with five replicates per treatment. Each test will be run for 96 hours. The fish test will be conducted as a static test with no renewal during the 96-hour testing period. The mysid test will be conducted as a static-renewal test. The mysid test chambers will be renewed at 48 hours with newly prepared elutriate samples. Elutriate concentrations will be prepared following the same procedure listed above. At the 48-hour time point, the animals will be counted and approximately 80% of the old solutions removed from the chambers. This is achieved by pouring off the test chamber through a screen into a secondary container, taking care not to lose the test organisms. Any organisms that are incidentally lost will be retained in the screen and may be returned to the test chamber with a large-bore transfer pipette. Daily water quality monitoring of test chambers will be carried out for pH, dissolved oxygen, salinity, and temperature. Ammonia will be analyzed at the start and the end of the test in the 100% concentration. Measurements in other concentrations will be performed only if the readings in the 100% concentration are greater than 4 mg/L total ammonia. To evaluate the relative sensitivity of the organisms, reference toxicity tests will be performed using reference toxicants (Lee 1980).

The mysid and fish test animals will be fed newly hatched Artemia sp. (brine shrimp) nauplii at a rate summarized in Table 13-7 below. Dry Artemia cysts will be obtained from Argent Labs or another equivalent supplier. Artemia cysts should have a hatch rate of >90% and nauplii size of less than 450 microns. Cysts will be kept dry in an airtight container at ambient room temperature for storage, and excess cysts will be kept in refrigeration. Artemia will be hatched daily for use in feeding tests and cultures of organisms. To prepare Artemia, approximately 1 liter of seawater (28±2 ppt) is added to a 2-liter separatory funnel. Approximately 1 gram of cysts is added to the separatory funnel and aerated at 20ºC to 25ºC. Artemia are collected after 24 hours by removing the aeration from the separatory funnel. Artemia will collect in the bottom of the funnel and can be drained into a container fitted with a ≤150-µm screen. The Artemia can then be rinsed with filtered seawater and concentrated using the screen. Artemia concentrate will be added to the test chambers using calibrated volumetric pipettes at the appropriate rate.

The zooplankton larvae test will be run on the test sediment elutriates at 100%, 50%, 30%, 10%, and 1% along with a seawater control and the dredging site water. There will be five replicates per treatment; a surrogate replicate will also be set up for use in water quality measurements. The test will be run for 48 hours, or longer if necessary, to ensure development of the larvae to the D-hinge (bivalve) or pluteus (echinoderm) stage in the control sample. At the termination of the study, survival and normal development will be compared between the control and test groups to determine if significant mortality or abnormal development exists.

Table 13-7 provides a summary of testing conditions for three water column species.

Table 13-7. Summary of Recommended Test Conditions for the Water Column Tests

Water Column Test Conditions			
Test Organism	**Mysid Shrimp**	**Fish**	**Larvae**
Age of Organism:	1-5 day old; ≤ 24 h range in age	9 – 14 day old; ≤ 24 h range in age	larvae, ≤ 4 h post fertilization
Test Type:	Static renewal	Static non-renewal	Static non-renewal
Duration:	96 h	96 h	48 - 54 h (bivalve) 48 - 96 h (echinoderm) When control treatment meets acceptability criterion
Test Chamber:	250 mL minimum	250 mL minimum	20 - 30 mL
# Organisms /Chamber:	10 minimum	10 minimum	15 to 30 embryos /mL
Test Volume:	200 mL minimum	200 mL minimum	10 – 30 mL
Replicates:	5 minimum	5 minimum	5
Sediment Holding Time	2 Weeks recommended < 8 weeks maximum	2 Weeks recommended < 8 weeks maximum	2 Weeks recommended < 8 weeks maximum
Water Quality:			
Temperature:	20 ± 1ºC; or 25ºC ± 1ºC Must not deviate by more than 3 ºC during the test	20ºC ± 1ºC; or 25ºC ± 1ºC Must not deviate by more than 3 ºC during the test	16ºC ± 1ºC (*M. edulis*) 25ºC ± 1ºC (*C. virginica*) 12ºC ± 1ºC (*S. purpuratus*)
Salinity:	Optimal: 30 ± 2 ppt Range: (20 – 30) ± 2 ppt	Optimal: 30 ± 2 ppt Range: (1 – 32) ± 2 ppt	Optimal: 30 ± 2 ppt Range: (18 – 32) ± 2 ppt
Aeration	None unless needed	None unless needed	None unless needed
Dissolved Oxygen:	≥ 60 % saturation 4.6 mg/L @ 30 ppt, 20 ºC	≥ 60 % saturation 4.6 mg/L @ 30 ppt, 20 ºC	≥ 60 % saturation 4.9 mg/L @ 30 ppt, 16 ºC 4.2 mg/L @ 30 ppt, 25 ºC
pH	7.8 ± 0.5	7.8 ± 0.5	7.8 ± 0.5
Dilution water	Natural seawater	Natural seawater	Natural seawater
Test elutriate concentrations	Three concentrations 100, 50, and 10%	Three concentrations 100, 50, and 10%	Five concentrations 100, 50, 30, 10, and 1%
Renewal of Test Solutions	At 48-hours	None	None
Feeding Schedule:	Twice Daily	At 48-hours	none
Ration/Diet	0.1 mL solution of <24 h old Artemia nauplii, twice daily (Total of 0.2 mL per day)	0.2 mL solution of <24 h old Artemia nauplii at 48 h	none
Lighting quality	Ambient lighting	Ambient lighting	Ambient lighting
Photoperiod	16L/8D	16L/8D	16L/8D
Endpoints:	Survival	Survival	Survival, normal larvae development to D-stage Prodissoconch or Pluteus
Test acceptability criteria	≥ 90% survival in control	≥ 90% survival in control	≥ 90% survival and ≥70% normal development in control (bivalve) ≥70% survival and normal l development (echinoderm)
Reference Toxicant	Copper Sulfate or Ammonium Chloride	Copper Sulfate or Ammonium Chloride	Copper Sulfate or Ammonium Chloride

Benthic Testing

Benthic bioassays will be performed to estimate the potential impact of aquatic disposal of the proposed dredge material on benthic organisms that attempt to re-colonize the area. Sediment will be tested in 10-day benthic tests using an amphipod species, *Ampelisca abdita* or *Leptocheirus plumulosus* (depending on sediment grain size) and a polychaete worm, Neanthes arenaceodentata. Each sediment type (test and control) will be run with five replicates. Control sediment will be sediment from the area where the organisms were collected (i.e., native sediment) or an alternative clean sediment source when a native sediment is not available.

Test organisms will be exposed to the sediment for 10 days in 1-liter glass test chambers in a static system. Two centimeters of sediment (approximately 150 mL) will be placed into each chamber with 775 mL of overlying water. Initial stocking densities in each replicate will be 20 organisms per test chamber for the amphipod test and five to ten organisms per chamber for the polychaete test. Trickle-flow aeration will be provided through glass pipettes in such a way as to avoid disturbing the sediment surface. Water quality measurements will be taken in one chamber from each test treatment daily and will include pH, salinity, temperature, and dissolved oxygen. Ammonia will be measured in both interstitial (pore water) and overlying water at the start and finish of the test from one replicate for each test sample. Sediment pore water will be extracted via centrifugation. All instruments used will be calibrated and logged daily. At the conclusion of the exposure period, using methods described in the ITM (EPA and USACE 1998), the sediments will be carefully sieved to remove the test organisms, and survivorship will be assessed. To evaluate the relative sensitivity of the organisms, reference toxicity tests will be performed using standard reference toxicants (Lee 1980). Table 13-8 provides a summary of testing conditions for benthic tests.

Table 13-8. Summary of Recommended Test Conditions for the Benthic Tests

Benthic Test Conditions		
Test Organism:	**Amphipod**	**Polychaete**
Age of Organism:	Sub-adults 3-5 mm in size (*A. abdita*) 2-4 mm in size (*L. plumulosus*)	2-3 weeks post emergence
Test Type:	Static, non-renewal	Static, non-renewal
Duration:	10-d	10-d
Test Chamber:	1-L	1-L
# Organisms /Chamber:	20	5-10
Test Sediment Volume/ Seawater Volume	175 mL sediment L / 775 mL overlying water	175 mL sediment L / 775 mL overlying water
Sediment Holding Time	2 weeks recommended < 8 weeks maximum	2 weeks recommended < 8 weeks maximum
Replicates:	5	5
Water Quality:		
Temperature:	20ºC ± 1ºC (*A. abdita*) 25ºC ± 1ºC (*L. plumulosus*)	20ºC ± 1ºC
Salinity:	*A. abdita* Optimal: 20 ± 2 ppt Range: (20 – 32) ± 2 ppt *L. plumulosus* Optimal: 20 ± 2 ppt Range: (1 – 32) ± 2 ppt	Optimal: 30 ± 2 ppt Range: (28 – 36) ± 2 ppt
Aeration	Trickle-flow (<100 bubbles/min.)	Trickle-flow (<100 bubbles/min.)
Dissolved Oxygen:	≥ 60 % saturation 4.6 mg/L @ 30 ppt, 20 ºC 4.2 mg/L @ 30 ppt, 25 ºC	≥ 60 % saturation 4.6 mg/L @ 30 ppt, 20 ºC
pH	7.8 ± 0.5	7.8 ± 0.5
Ammonia Limits	< 20 mg/L interstitial total ammonia	< 20 mg/L interstitial total ammonia[1]
Overlying Water	Natural seawater	Natural seawater
Feeding Schedule:	None	None
Ration/Diet	Not applicable	Not applicable
Lighting Quality	Ambient	Ambient
Photoperiod	Continuous	Continuous
Endpoints:	Survival	Survival
Test Acceptability Criteria	≥ 90% survival in control	≥ 90% survival in control
Reference Toxicant	Cadmium chloride or ammonium chloride	Cadmium chloride or ammonium Chloride

[1] This is a conservative ammonia threshold value based on amphipod species tolerance. *N. arenaceodentata* are considered to be tolerant of higher levels of ammonia.

13.3.2.1 Ammonia-Reduction Procedure--SERIM Appendix N

Ammonia is considered a non-persistent contaminant of concern and should be reduced below biological threshold levels prior to the introduction of test organisms. This is partly because ammonia is an artifact of sediment collection and storage, and its related effects will be ameliorated during the proposed disposal process as the sediment falls through the water column. Reduction of elevated ammonia levels is desired to allow the assessment of sediment toxicity without the contributing factor of ammonia, which is reduced in the benthic bioassay through overlying water exchanges in the test chambers. For this procedure, the sediments are layered into the test chambers with 175 mL of sediment and 775 mL of seawater in a 1-liter glass jar. Five standard replicates are set up for each test, along with additional surrogate chambers for monitoring ammonia. Twice-daily water renewals are performed on the overlying water of the test chambers by siphoning off the water and gently pouring water back into the chamber using a diffuser to minimize sediment disturbance. Ammonia concentrations are measured in the overlying and porewater of the sediment during the ammonia reduction. Once the ammonia concentration in the sediment porewater falls below threshold values for the test species, the test can be initiated. If there is reason to believe that ammonia levels may increase during the course of the 10-day exposure, renewals may be continued at a maximum of twice daily.

Elevated ammonia levels also have the potential for causing toxicity in the water column tests, particularly with the sensitive larval development test. If the levels found in the prepared elutriate are greater than 25 mg/L for the Mysid or *Menidia*, or greater than 5 mg/L in the larval test, the laboratory may use an ammonia-reduction procedure prior to preparation of the sample for analysis. The ammonia-reduced sample will be run side by side with the unreduced sample. If the results indicate that the 100% concentration in the reduced sample is statistically the same as in the control, an application factor of 0.05 may be used for STFATE modeling instead of the standard value of 0.01. The revised application factor will be used only with the results from the analysis that did not undergo the ammonia reduction. Table 13-8 provides a summary of testing conditions for benthic tests.

Benthic Bioaccumulation Testing

Assessment of bioaccumulation potential will be carried out using the polychaete worm *Neanthes virens* and the bivalve *Macoma nasuta* over a 28-day exposure period. Each test will be initiated using test, reference, and control samples. Pre-exposure tissue samples will be archived in triplicate for both species for estimation of baseline tissue concentrations. Five replicate tests will be performed for each composite sample. *N. virens* and *M. nasuta* will be tested in separate 10-gallon aquaria using a minimum of 20 animals per replicate for the polychaete and a minimum of 25 animals per replicate for the bivalve.

The test chambers will be maintained under flow-through conditions, and daily water quality measurements will be taken in one chamber from each test treatment daily. Continuous seawater flow for the bioaccumulation test is achieved through gravity-fed manifolds with adjustable valves. Flow rates are maintained in the 10-gallon aquaria at 6 to 10 water exchanges per day (111 to 185 L/day).

On Day 28, the sediment will be sieved to remove the worms and clams. The surviving animals will be placed in clean flow-through aquaria to purge their gut contents for 24 hours, after which tissues will be placed into certified-clean glass sample jars, frozen, and sent to the chemistry laboratory for tissue analysis. If mortality exceeds 10% in reference or test dredge material, discussion with the regulatory agencies will occur regarding reduced tissue volume for chemical

analysis (which could result in the necessity of increased chemical detection limits and/or compositing of replicates).

The analysis of bioaccumulation will be made by statistically comparing tissue results from the test group to published threshold values for each species. The analysis will be conducted using analysis of variance, t-tests, or non-parametric tests, depending on the distribution of the data and whether the data meet the assumptions (i.e., normality and homogeneity of variance) of the individual tests as specified in the ITM (EPA and USACE 1998). Contaminant concentrations found to be significantly elevated above reference will be interpreted with criteria specified in the published bioaccumulation guidance documents.

Table 13-9 provides a summary of testing conditions for bioaccumulation tests.

Table 13-9. Summary of Recommended Test Conditions for the Bioaccumulation Potential Tests

Bioaccumulation Test Conditions		
Test Organism	***N. virens***	***M. nasuta***
Age of Organism	Adult	Adult
Test Type	Continuous flow-through	Continuous flow-through
Duration	28-d	28-d
Test Chamber	10 Gallon Glass Aquaria (49.5 x 24.8 x 29.2 cm)	10 Gallon Glass Aquaria (49.5 x 24.8 x 29.2 cm)
# Organisms /Chamber	25	25
Test Sediment Volume/ Seawater Volume	4 – 5 L sediment (4-5 cm) / 18.5 L of overlying seawater	4 – 5 L sediment (4-5 cm) / 18.5 L of overlying seawater
Water renewal flow rate	Recommended: 5 – 8 volumes/day	Recommended: 5 – 10 volumes/day
Sediment holding time	2 Weeks recommended < 8 weeks Maximum	2 Weeks recommended < 8 weeks Maximum
Replicates	3 Control, 5 Test	3 Control, 5 Test
Water Quality		
Temperature	10 ± 5ºC	12 – 16 ± 1ºC
Salinity	Optimal: 30 ± 2 ppt Range: (25 – 35) ± 2 ppt	Optimal: 30 ± 2 ppt Range: (25 – 35) ± 2 ppt
Aeration	Trickle-flow (<100 bubbles/min.)	Trickle-flow(<100 bubbles/min.)
Dissolved Oxygen	≥ 60 % saturation 5.0 mg/L @ 30 ppt, 15 ºC	≥ 60 % saturation 5.0 mg/L @ 30 ppt, 15 ºC
pH	7.8 ± 0.5	7.8 ± 0.5
Ammonia limits	Not applicable	Not applicable
Overlying Water	Natural seawater	Natural seawater
Feeding Schedule	None	None
Lighting Quality	Ambient	Ambient
Photoperiod	12L/12D	12L/12D, 16L/8D, or 10L/14D
Endpoints	Bioaccumulation	Bioaccumulation
Test Acceptability Criteria	≥ 90% survival in control and reference treatments; ≥ 75% survival in test treatments; or sufficient tissue mass for analytical chemistry	≥ 90% survival in control and reference treatments; ≥ 75% survival in test treatments; or sufficient tissue mass for analytical chemistry
Reference Toxicant	Copper Sulfate	Copper Sulfate

Potential Contributing Factors to Toxicity

Additional testing may be needed to address acclimation of sediment to testing conditions. Any proposed treatment of the sediment will be discussed with, and a written procedure approved by, USACE and EPA before its implementation.

Although not likely, new work samples may have slightly lower salinity than typical ocean sediments. Therefore, acclimatization of the sediment may be required. The decision will be made after sample collection. An estimate of the sample porewater salinity will be made by Ramboll ENVIRON and used to determine if acclimatization is necessary. USACE and USEPA will be consulted on this evaluation prior to sending samples to the toxicology laboratory.

The lower salinity would likely to be a concern with both the solid phase and bioaccumulation tests. Since the suspended particulate phase tests assess the toxicity of the sediment/water elutriate, the salinity will be less of a concern for these tests.

The concern with salinity includes (a) making sure the material being tested is at the appropriate salinity for the test organisms and (b) making sure the material being tested is capable of supporting marine life. The act of quickly forcing a soil or freshwater sediment to marine conditions can create artificial toxicity when tested immediately with marine organisms (and the known absence of any contaminants of concern). An acclimatization process that allows the material to equilibrate to the new ionic balance and develop its own community of marine microorganisms will be performed if required. This process is often accompanied be a shift in ammonia concentrations as the material equilibrates both chemically and biologically. This ammonia spike is another cause of artificial toxicity if organisms are added prior to this event. Knowing about this shift in ammonia concentration gives us a tool for determining when an acclimation process has been completed.

This acclimation process typically takes about 2 weeks, but could vary from 7 to >30 days. Since the material to be tested does get exposed to brackish conditions, it is likely that this process would be short (7 to 14 days). The process follows the same test set-up procedures; however, 4 to 6 additional sacrificial chambers would be set-up to monitor water quality and ammonia levels that would indicate the equilibration shift.

Seawater for Bioassay Testing

For the water column tests, project site water will be used to create the elutriate preparations. The elutriate preparation involves the use of the dredge material (sediment) and unfiltered dredging site water which are combined in sediment-to-water volumetric ratio of 1:4. All other seawater used for the biological tests, including the flow-through studies, will come from the northern Hood Canal at Port Gamble, Washington. This seawater source has been used successfully with acceptable survival on similar bioassay testing programs by EcoAnalysts. Extensive testing on a variety of test species has shown that there is no significant potential for toxicity or bioaccumulation from these water supplies.

14.0 ELEMENT B5 - QUALITY CONTROL REQUIREMENTS

Section 7.0 shows a list of key quality control indicators used to evaluate laboratory performance and, ultimately, the usability of the results. These indicators are described in more detail in the following sections along with corrective actions, if appropriate, or justifications for acceptance of results that fall outside standard acceptance criteria.

14.1 Field Analysis

All field analyses will be performed by ANAMAR personnel. ANAMAR maintains strict quality assurance protocols in the field, including instrument calibration, decontamination, field custody sheets, and corrective action, if required. All QC is completely documented and included in the final report to the client. QC for in situ analyses is discussed in Section 16.0.

Sample acceptability for sediment grab is discussed in detail in Section 11.1.

14.2 Physical Analysis

All physical analyses will be performed by Terracon in Jacksonville, Florida. Terracon maintains laboratory SOPs and a Quality Manual as part of their overall quality assurance program. Terracon's quality assurance program consists of routine analysis of proficiency testing samples and laboratory duplicates. Project-specific QC may be requested if not part of the routine QC performed. Laboratory replicates will be the primary QC indicator for acceptance or rejection of results. Sample precision is calculated as described in Section 14.3.2.5. QC that falls outside these limits shall be investigated, including a determination of sample heterogeneity and discussion with the laboratory. Results that cannot be satisfactorily explained will be rerun.

14.3 Chemical Analysis Quality Control

All chemical analyses will be performed by ALS Environmental, Inc., a NELAC-accredited laboratory, according to NELAC standards. The Quality Assurance Manual (QAM) and SOPs for ALS clearly specify quantitative and qualitative objectives for each analysis, such as MDLs, precision, accuracy, completeness, representativeness, and comparability. The QAM and SOPs will be strictly adhered to for all analyses completed under the project.

Laboratory QC for chemical analysis can be broken into two distinct categories: batch or run QC and sample QC. Batch QC is used to ensure that the analytical instrument is operating properly through the entire run. Sample QC is used to establish the accuracy of the results reported. Below are brief descriptions of the various QC activities typically performed.

14.3.1 Batch QC

14.3.1.1 Method Detection Limit and Method or Laboratory Reporting Limits

MDLs are statistically determined concentrations the laboratory can report with 95% confidence that the analyte is present or absent. The procedures for determining the MDLs can be found in 40 CFR Part 136, Appendix B.

LRLs provide a concentration the laboratory can report data with quantitative accuracy in the results. Typically, a laboratory will define its LRL as either equal to their lowest calibration standard or equal to a fixed factor above their MDL. These definitions will vary among laboratories based on factors such as laboratory instrumentation, methods used, sample dilutions, and sample properties, including matrix interferences. The laboratory may adjust its reporting limits based upon historical results of the samples, if available.

14.3.1.2 Initial Calibration

The initial calibration of analytical instrumentation consists of preparing a set of calibration standards that covers the instrument's dynamic range and measuring the responses for each standard. Statistical calculations are then applied to the standards and responses to prepare an initial calibration curve that is used to determine the concentration in the project samples. For organic compounds, a relative response factor is determined for each set of standards, and a limit of 20% relative standard deviation is used for the acceptance criterion. For most general chemistry and some metals analytes, linear regression is used, and the calculated correlation coefficient must be greater than 0.995 to meet the acceptance criterion. ICP and ICP/MS analyses use a single-point calibration and use other batch QC for determining acceptability of the initial calibration. The analysis of physical parameters (such as grain size and moisture content) does not use initial calibration. If the initial calibration does not meet its acceptance criteria, the run is stopped until the problem has been corrected. No sample may be reported using an initial calibration that has failed to meet its acceptance criterion.

14.3.1.3 Initial Calibration Blank and Continuing Calibration Blank

ICBs and CCBs are prepared blanks matching the matrix of the calibration standards and samples. They have non-detectable concentrations of the analytes to be tested and are used to ensure that the initial calibration provides a non-detectable response during analysis. If the response is at a detectable level, either positive or negative, then the ICB and the CCB should be evaluated to determine the cause.

14.3.1.4 Initial Calibration Verification

The ICV is a sample or standard prepared at a known concentration and run against the initial calibration. It is prepared using a second source distinct from the initial calibration standards. The measured concentrations should be within a range specified by the methodology or client. If the measured results fall outside the acceptance criterion, the laboratory must investigate the cause and take corrective action before any samples may be analyzed and reported. Such actions may include re-preparation of the ICV, recalibration of the instrument, or instrument repair if it is not functioning to specifications.

14.3.1.5 Continuing Calibration Verification

The CCV is a standard prepared at a known concentration and run at specific intervals throughout the course of an analytical run. Typically, CCVs are performed at the beginning of a run, after every 10 or 20 samples, after every 12 hours, and at the end of an analytical run. The CCV ensures that the calibration is acceptable throughout the entire course of a run. If a CCV falls outside its acceptance criterion, the analyst should evaluate the cause and determine appropriate corrective action. Since there will be numerous CCVs on a single analytical run, one CCV that is out of acceptance criteria does not necessarily indicate an initial calibration that has fallen out of control, particularly if the next CCV in the analytical sequence is within acceptance criteria. All CCV results must be reviewed before the usability of the sample results is assessed.

14.3.2 Sample QC

14.3.2.1 Sample Homogeneity/Heterogeneity and Matrix Interferences

While not explicitly a part of sample QC, these terms describe the physical and chemical characteristics of a project sample with regard to the ability to accurately measure the concentration of a contaminant. The gross physical characteristics of a project sample will be

affected by its homogeneity/heterogeneity. Homogenous samples will be composed almost entirely of one type of material with a uniform appearance and grain size. Heterogeneous samples will be composed of several types of material that will not homogenize completely in a timely manner using readily available mixing techniques, e.g., a primarily silty material with gravel and pockets of clay. Other examples of materials that contribute to a heterogeneous sample include oily sheens or detrital material from decaying plants.

Matrix interferences are encountered during chemical analysis when the project sample contains a constituent that either produces a signal indistinguishable from a target analyte or attenuates the target signal. Ocean dredging projects have many common types of matrix interferences, e.g., saline in elutriate samples for trace metals. In addition, the chemical composition of the project samples may have interfering compounds specific to the sampling location. Laboratory methodology has been developed to address the most common interferences, either through laboratory sample preparation or by adjusting instrument settings for specific sample matrices. If such procedures cannot completely eliminate an interference, the data will be qualified or the MDL and LRL will be elevated and an explanation for the interference will be provided by the laboratory.

14.3.2.2 Method Blank

A method blank is prepared with every 20 project samples or sample batch if less than 20 samples are submitted with a project. It is prepared in exactly the same way as the project samples and is used to show that the preparation did not contribute any contamination to the samples. If a method blank does indicate that contamination is present, the associated project samples may still be reported if the concentration of contaminant in the project samples is sufficiently greater (e.g., 10 times the level in the method blank) if all sample concentrations are below the target detection limit or if all sample concentrations are below any guidance criteria. If none of these conditions apply, the results should be qualified and accepted or rejected on a case-by-case basis.

14.3.2.3 Standard Reference Material

An SRM is a QC sample that has known concentrations of contaminants that have been determined either through extensive analysis of real-world samples or through the introduction of target contaminants into a clean material. An SRM is prepared with every batch in exactly the same way as the project samples, and the SRM material should match the matrix of the material being tested as closely as possible. While control or guidance limits are typically provided by the manufacturer, they may be based on analytical procedures that are not used in the analysis of the project samples described in this QAPP. In this case, the laboratory should substitute the manufacturer's limits with their own limits determined over the course of multiple analysis of the SRM.

14.3.2.4 Sample Bias

Sample bias is measured through matrix spikes, which are prepared by adding a known concentration of an analyte to an aliquot of sample, which is called a sample spike. Once prepared and analyzed, spike recovery can be determined by subtracting the concentration of the analyte in the unspiked sample from the concentration in the spiked sample and comparing the result to the known concentration that was added. Biases in the sample will yield either low or high recoveries outside the acceptance criteria and are typically the result of matrix interferences. Heterogeneity in the sample may also result in spikes outside the acceptance criteria. The

analysis of spike duplicates can often confirm the presence of a matrix interference in the sample if the spike and spike duplicate show similar results.

14.3.2.5 Sample Precision

Sample precision is measured through field splits, sample duplicates, and matrix spikes/matrix spike duplicates. The most common measure of precision is the relative percent difference (RPD), which is the ratio of the difference between two readings and the average of the two readings. A typical acceptance limit for precision is 30% RPD. When the two results are either non-detected or just above the detection limit, the calculated RPD will not be usable and MS/MSDs should be used instead. MS/MSDs that fall outside the precision acceptance criteria should be rerun or a detailed explanation should be provided in the laboratory case narrative justifying its use. Matrix interferences and sample heterogeneity will contribute to poor precision in the samples.

14.3.2.6 Anomalous Results

Where sample or QC results stand out individually (e.g., a single detected organic compound in a sample with all remaining results equal to non-detects, or a single spike at 10% with all other spikes in the sample being greater than 70%), an investigation into the anomalous result will be initiated by ANAMAR's QA officer. This investigation will include an evaluation of the physical and chemical characteristics, a review of the laboratory results and raw instrument data, and discussion with the laboratory to determine a plausible explanation for the anomaly. Where necessary, the client and the regulatory agency will be contacted to determine whether the result will be accepted or if further corrective action will be required.

14.3.2.7 Internal Standards and Surrogates

Internal standards are organic compounds similar to the analytes of interest but are not found naturally in normal environmental samples. These compounds are added prior to instrument analysis to all project and QC samples, instrument blanks, and standards. The selected internal standards are used to help calibrate the instrument's response and to compensate for slight variations from one injection to the next.

Surrogates are organic compounds similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. The purpose of surrogates is to evaluate the extraction and analysis of samples. These compounds are added to all samples and associated extracted QC samples.

Recovery of internal standards and surrogates should meet laboratory criteria. Failure to meet the specified criteria should be investigated by the laboratory; however, limited numbers of isolated failures do not necessarily indicate that the data are unusable. All failures should be addressed by the laboratory in the report case narrative.

14.4 Toxicological Quality Control

All toxicological analyses will be performed by EcoAnalysts in Port Gamble, Washington. EcoAnalysts' laboratory maintains a quality assurance program that is strictly adhered to. QC is thoroughly documented and submitted with the final report. All applicable test conditions will follow published requirements for each species used, and the final report shall include all applicable test conditions. The final report shall also include statistical analysis of the results, which will be compared to EPA Region 4 acceptance criteria.

14.4.1 Test Organism Condition

Age and/or size class of test organisms must conform to the individual test procedures. Animals should be acquired at least 1 day prior to test initiation so that acclimation to test conditions can occur and any mortality due to shipping conditions can be observed. All test organisms shall appear healthy, show no signs of stress, and exhibit acceptable survival during the holding period. When these conditions are not met, the batch of organisms should be replaced with healthy organisms. New organisms may be obtained from

- The same supplier, with corrective actions taken to improve organism health upon arrival;
- Alternate suppliers; or
- The collection of animals from different locations (for field-collected organisms).

In some cases, alternate approved species may be substituted to accommodate differing spawning windows or availability.

14.4.2 Control Sample

The control sample is a negative control for the matrix tested. Clean laboratory seawater is used as the negative control and diluent for the water-column tests; native sediment is used whenever possible in sediment tests. For species that are routinely laboratory-cultured and do not have a true "native" sediment (e.g., Neanthes arenaceodentata), sediment from a known clean source that is compatible with the biological needs of the test species is used for control testing. This may be a native sediment used for another field-collected species. The negative control is included for each test to evaluate test performance and the health of the specific batch of test organisms. Each test procedure has established limits on control sample performance. Failure of a control sample to meet the test criteria may indicate that the test organisms were insufficiently healthy to provide a valid test or that procedural problems existed that would invalidate the test results. In the event of a control sample failure to meet test criteria, the client and regulatory agencies will be notified and a corrective action implemented. The failed test will be reviewed to determine if a potential cause of excess negative response can be identified. This will include a review of the water quality observations, daily test observations, reference toxicant results (positive control), and any other useful anecdotal observations.

If the control fails to meet acceptance criteria, the data may still be conditionally accepted on a case-by-case basis. Factors that may influence the decision should be addressed by all interested parties (laboratory, contractor, client, and regulatory) and include the following situations:

- The control failure is driven by a single replicate that can be identified as a potential outlier.
- The associated treatment data meet control acceptability criteria (and no other significant deviations occur).

If a retest is warranted, corrective actions will be implemented to limit the possibility of recurrence. This will include obtaining organisms from a different supplier and/or collection site (if feasible) or holding animals for a longer period to ensure health.

14.4.3 Reference Toxicant Test

Reference toxicant tests are used to measure the health of a batch of organisms. A known concentration series of a standard reference toxicant is used to test each batch of test organisms for acute survival. After the test has been run, statistical analysis is performed on the results to

determine if the organisms were consistent with prior organisms tested. A database of the toxicant results (LC_{50}) for each species and test is maintained. Test results falling within the 95% confidence limits (±2 standard deviations) of the historical laboratory mean indicate that the batch of test organisms used was of similar sensitivity to the toxicant as those previously tested. An LC_{50} that falls below the lower limit indicates the batch of test organisms was more sensitive than others tested; conversely, an LC_{50} above the upper limit indicates a lower sensitivity. Reference toxicant tests with results falling outside the confidence limits do not invalidate a test because 5% of results could reasonably be expected to fall outside the limits. Such data are evaluated in comparison with the control chart characteristics, including the range of acceptance limits and the degree of departure. Consecutive reference toxicant test results outside acceptable limits would trigger a laboratory review of the test procedures for deviations and possible corrective action.

14.4.4 Water Quality Monitoring

Water quality monitoring of test chambers provides documentation that testing parameter limits for each procedure were met throughout the duration of the test. Routine calibration of measurement probes per manufacturer's instructions ensures consistency in readings. Measurements are taken daily or as proscribed by the test procedure. An individual test may be acceptable even if temperature, dissolved oxygen, pH, or salinity fall outside recommended specifications, depending on the degree of deviation and the objective of the test. When feasible, corrective actions are performed to bring an out-of-range observation back to within parameters without adversely influencing the test (e.g., temperature control or aeration addition). These actions are taken immediately upon discovery and are considered standard procedure. Recommended ranges are typically well within the natural tolerance limits of the test organisms. When deviations occur, test acceptability falls to the experience and professional judgment of the technical director and the permitting authority responsible for accepting the test results.

Additional QC acceptance criteria for toxicological analyses is shown below in Sections 14.2.5 through 14.2.7.

14.4.5 Water Bioassay Samples

(See Green Book Section 11.1 -- Tier III: Water-Column Bioassays, for details.)

- Reference toxicant tests -- Geometric dilution series of five unreplicated concentrations, one of which must give >50% mortality and one of which must give <50% mortality; conducted once monthly per laboratory-cultured species and on each lot of purchased or field-collected organisms; 10 organisms per exposure chamber; 96-hour exposure (48-hour minimum for bivalve larvae); no sediment; artificial seawater or clean natural seawater used as the diluent, depending on which was employed in the bioassays.
- Control mortality ≤10% mean (≤30% abnormal development for live oyster and sea urchin larvae).

14.4.6 Sediment Bioassay Samples

(See Green Book Section 11.2 -- Whole-Sediment Bioassays, for details.)

- Reference toxicant tests -- Geometric dilution series of five un-replicated concentrations, one of which must give >50% mortality and one of which must give <50% mortality; conducted once monthly per laboratory-cultured species and on each lot of purchased or field-collected organisms; 10 organisms per exposure chamber; 10-day exposure; artificial seawater or clean natural seawater used as the overlying water, depending on which was employed in the bioassays.
- Ammonia in the overlying water and porewater will be monitored; appropriate action as described in the ITM (EPA and USACE 1998) and/or the SERIM (EPA and USACE 2008) will be taken for any ammonia results above limits recommended in the SERIM (<40 mg/L; see SERIM Table 6-2 for Leptocheirus plumulosus).
- Control mortality ≤10% mean (amphipods control mortality ≤10% mean and no individual chamber ≥20% mortality).

14.4.7 Sediment Bioaccumulation Samples

(See Green Book Section 12.1 -- Tier III: Determination of Bioavailability, for details.)

- Reference toxicant tests -- Geometric dilution series of five un-replicated concentrations, one of which must give >50% mortality and one of which must give <50% mortality; conducted once monthly per laboratory-cultured species and on each lot of purchased or field-collected organisms; 20 to 25 organisms per exposure chamber; 28-day exposure; artificial seawater or clean natural seawater used as the diluent, depending on which was employed in the bioaccumulation studies.

Where control mortality is >10%, determine if the following conditions exist:

a. adequate replicates to obtain statistical power;
b. stressed organisms;
c. contaminated control sediment;
d. contamination of test system;
e. quality control problems; and
f. adequate tissue for chemical analyses

Tissue samples from the 28-day bioaccumulation tests will be analyzed for the constituents listed previously; the list of constituents may be adjusted based on examination of sediment chemistry results. Each series must include a minimum of five replicates of test sediment, five replicates of reference sediment, and three replicates of control sediment. An analysis will be made for each replicate. A minimum of 20 organisms per replicate is required for each test chamber, although more organisms may be required to conduct the specified tissue analyses at the end of the test exposure. All tissues will be depurated for 24 hours in clean sand prior to freezing.

14.5 Data Quality Objectives for Chemical Analyses

Achieving the desired LRLs is critical to providing a suitable evaluation of the COCs and the suitability of the sediments for ocean disposal. The laboratory must perform yearly MDL verification studies in accordance with NELAC standards on the matrices tested under this project. The most recent MDL verification studies on sediment, water, and tissue matrices are provided in Attachment 5.

The final report will include detailed explanations when the actual LRLs exceed those listed in Tables 13-2 through 13-5 and/or when an alternative test method is used. Any deviation from the proposed methods will receive prior approval from USACE and EPA. The most recent MDL concentrations on sediment, water, and tissue matrices are provided in Attachment 5. Full confirmation studies are available on request.

ANAMAR will use the data quality review form from Appendix O of the SERIM for evaluating laboratory QC.

14.6 USACE- and EPA-Specific Data Quality Objectives

Appropriate standard quality-control checks such as those described in Sections 14.1 through 14.4 shall be incorporated into all laboratory activities and described in the laboratory's QAM and SOPs.

The QAM and SOPs will list the analytical equipment used for testing, along with relevant calibration and standard reference materials used, maintenance schedules, and recordkeeping methods. The accuracy and precision limits included in the analytical laboratory's QAM and SOPs will meet the criteria established for this evaluation. The laboratory managers/directors will be responsible for assigning appropriately trained analysts to perform the specific tests. As part of the NELAC certification, corrective procedures have been established if QA objectives are not met.

All physical and chemical data must conform to the data quality objectives listed in Table 14-1. All toxicological data must conform to the data quality objectives listed in Tables 14-2 and 14-3. For all data quality objectives that are not achieved, the laboratory will provide documentation for the failed criteria and any corrective action taken and/or re-analyze the samples. All analytical anomalies will be described in detail in the final report.

Table 14-1. Data Quality Objectives for Sediment, Elutriates, Site Water, and Tissue Chemical Analyses

Parameter	QC Measurement	Frequency	Acceptance Criteria	Storage/Holding Times
PAHs, PCBs, and Pesticides	MB	1 per 20 samples or 1 per batch up to 20	No analyte should be detected > reporting limit (RL)	14 days until extraction, 40 days for analysis of the samples after extraction
	MS/MSD	1 set per 20 samples or 1 set per batch up to 20 samples	50 - 150% for spike limits 50% RPD for precision	
	Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RPD for precision (Evaluated for analytes >3x RL)	
	SRM**	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider (Evaluated for analytes >3x RL)	
	ICV	Immediately following calibration curve	80 - 120% Recovery	
	CCV	Minimum - one per 10 samples and at the end of each batch whenever batch is greater than 10 or for GC/MS at the beginning of every 12 hours	RRF or RF ≤25% for GC/MS methods and ≤15 for all other methods	
	Surrogates	Every sample	30 - 150% Recovery	
	Internal Standard	Every sample	50 - 200% Recovery	
	IC	Verify after each initial calibration	<20% RSD for each analyte or RF ≤30% for GC/MS	
	MDL	Verify MDL study Updated annually once per year for each analyte of interest	Updated annually	

Table 14-1. Data Quality Objectives for Sediment, Elutriates, Site Water, and Tissue Chemical Analyses

Parameter	QC Measurement	Frequency	Acceptance Criteria	Storage/Holding Times
Metals	MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL	180 days
	MS/MSD	1 set per 20 samples or 1 set per batch up to 20 samples	70 - 130% for spike limits	
	Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RPD (Evaluated for analytes >3x RL)	
	SRM	1 per 20 samples or 1 per batch up to 20 samples	70 - 130% Recovery (Evaluated for analytes >3x RL)	
	LCS/LFB	1 per 20 samples or 1 per batch up to 20 samples	70 - 130% Recovery	
	ICV	Immediately following calibration curve	90 - 110% Recovery	
	CCV	Minimum - one per 10 samples and at the end of each batch whenever batch is greater than 10	90 - 110% Recovery	
	LDR	Verify LDR once per quarter for ICP analysis and one time for mercury analysis	Refer to frequency	
	Initial Calibration for AA, Hg	Performed daily	Correlation coefficient ≥ 0.995	
	MDL	Verify MDL study once per year for each analyte of interest	Updated annually	
	ICB	Immediately after initial calibration	No analyte should be detected > RL	
Dioxins	MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL	30 days until extraction, 45 days for analysis of the samples after extraction
	LCS	1 set per 20 samples or 1 set per batch up to 20 samples	70-130% for spike limits	
	MS/MSD or LCS/LCSD	1 per 20 samples or 1 per batch up to 20 samples	70-130% recovery and less than 20% RPD for precision	
	ICV	Immediately following calibration curve	50-150% Recovery	

Table 14-1. Data Quality Objectives for Sediment, Elutriates, Site Water, and Tissue Chemical Analyses

Parameter	QC Measurement	Frequency	Acceptance Criteria	Storage/Holding Times
	CCV	At the beginning of every 12 hours of analysis	80-120% Native standards 65-135% for labeled standards	
	Initial Calibration Standards	Once per run	80-120% Native standards 65-135% for labeled standards	
Organotins	MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL	14 days until extraction, 40 days after extraction
	MS/MSD	1 set per 20 samples or 1 set per batch up to 20 samples	60-140% for spike limits 40% RPD for precision	
	Duplicate	1 per 20 samples or 1 per batch up to 20 samples	40% RPD for precision (Evaluated for analytes >3x RL)	
	SRM**	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider (Evaluated for analytes >3x RL)	
	ICV	Immediately following calibration curve	75-125% Recovery	
	CCV	At the beginning of every 12 hours of analysis	75-125% Recovery	
	Surrogates	Every sample	20-150% Recovery	
	IC	Verify after each initial calibration	<20% RSD	
	MDL	Verify MDL study once per year for each analyte of interest	Updated annually	

Table 14-1. Data Quality Objectives for Sediment, Elutriates, Site Water, and Tissue Chemical Analyses

Parameter	QC Measurement	Frequency	Acceptance Criteria	Storage/Holding Times
TOC	MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL	28 days
	MS/MSD	1 set per 20 samples or 1 set per batch up to 20 samples	75 - 125% for spike limits 20% RPD for precision (Evaluated for analytes >3x RL)	
	Triplicate	1 per 20 samples or 1 per batch up to 20 samples	20% RSD for precision (Evaluated for analytes >3x RL)	
	SRM*	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider (Evaluated for analytes >3x RL)	
	ICV	Immediately following calibration curve	80 - 120% Recovery	
	CCV	At the beginning of every 12 hours of analysis	90 - 110% Recovery	
	IC	Verify after each initial calibration	cc > 0.9950 for all calibrations	
	MDL	Verify MDL study once per year for each analyte of interest	Updated annually	
Grain Size	Triplicate	1 set per 20 samples or per batch	<20% RSD	Undetermined
% Solids and Specific Gravity	Duplicate	1 set per 10 samples or per batch	Within 20% Relative % Difference	Undetermined

* If SRMs are not available, use laboratory control samples.

Table 14-2. Toxicology Project Checklist

Part I. General Data Reporting Requirements	
SUMMARY TABULAR DATA AND PROJECT NARRATIVE **Each of the following elements should be present as described.**	
	A summary table listing the percent survival in all control, reference, and test samples
	A summary table containing the t-tests from the solid phase tests and the LC_{50}/EC_{50} values for the suspended particulate phase (SPP) tests
	A narrative that summarizes all of the deviations from the Green Book and Regional Guidance Manual protocols. Deviations of sample handling, test conditions, ammonia purging procedures, control performance, reference toxicant test performance, organism handling/acclimation, and water quality parameters should be provided in this section.
	A summary table that documents collection dates and holding times for the test, control, and reference sediment samples. Holding times for site water, SPP, and lab saltwater for all tests should be included in this table.
	The data narrative should describe the major biological project activities and results. Computerized tables of results, water quality, and other pertinent information should be placed in this portion of the biological data package.

RAW BIOLOGICAL AND WATER QUALITY DATA FROM TESTS	
	Survival Data
	Water Quality Parameters
	Feeding Schedule and Amount (if applicable)
	Organism Observations
	Summary of Test Conditions

TEST ORGANISM HOLDING, HANDLING, AND ACCLIMATION	
	Organism Shipping Data Sheet Provided by Supplier
	Copy of Overnight Shipping Airbill (if applicable)
	Internal Receiving and Distribution Data
	Holding/Acclimation Records (including water quality, renewals, and feeding)
	Mortality during Holding and Acclimation
	Taxonomic Identification for Each Species

REFERENCE TOXICANT DATA	
	Raw Bench Sheets for Reference Toxicant Tests
	Reference Toxicant Stock and Test Solution Preparation Sheet
	LC_{50}/EC_{50} Statistical Calculations
	Updated Reference Toxicant Control Charts with Acceptability Limits

STATISTICAL DATA FROM DREDGE MATERIAL TESTS	
	Provide all computer-generated LC_{50}, EC_{50}, and/or t-test spreadsheets or graphical interpolations for the SPP and solid phase tests.

INVALID TEST DATA	
	If a test was repeated for any reason, the data from the original test must be included in the final report. If a serious deviation occurs which has the potential to affect test acceptability, USACE and EPA Region 4 must be contacted immediately to determine if a retest is needed.

Table 14-2. Toxicology Project Checklist

Part II. **Test-Specific Information (additional to items specified in Part I)**	
AMPHIPOD SOLID PHASE TEST	
	Pretest Overlying Water Renewal Log and Total Porewater Ammonia Data
	Total/Un-ionized Porewater Ammonia Measured in Dummy Jars during Testing

POLYCHAETE SOLID PHASE TEST	
	Pretest Overlying Water Renewal Log and Total Porewater Ammonia Data
	Total/Un-ionized Overlying Un-ionized Ammonia Measured during Testing

SUSPENDED PARTICULATE PHASE TESTS (SPP)	
	SPP Preparation Log (All Volumes, Mixing Times, Centrifuge Information, etc.)
	Raw Data for Bivalve Gamete Collection and Preparation

BIOACCUMULATION TESTING	
	Daily Flow Calibration Log – Initial and Final Adjusted Flows
	Pre- and Post-test Depuration Logs – Time Started/Ended and Flow Rates
	Receiving Logs for All Natural Saltwater (If Collected)
	Preparation Logs for All Artificial Saltwater
	If Control Survival <90%, Provide Detailed Narrative for the Five Factors
	Raw Statistical Data Comparing Test and Reference Tissue Chemistry

SAMPLING / SAMPLE HANDLING	
	Chain-of-Custody Forms for All Test, Control, and Reference Samples
	Field Data Sheets and/or Sampling Logs (Including Photos If Available)
	Log of Test Sediment Composite Preparation
	Sieving – Size of Mesh Used for toxicity Test/Bioaccumulation Samples
	Holding Times for All Samples (Test, Reference, Control, Elutriate, Lab Saltwater) in Summary Chart Format

Table 14-3. Toxicology Data Checklist

	Solid Phase Test		Suspended Particulate Tests			Bioaccumulation Tests	
	Amphipod	**Polychaete**	**Fish**	**Mysid**	**Bivalve Larvae**	**Sand Worm**	**Clam**
Test Species: Identify each species used for toxicology in the cells to the right							
Correct species used as stated in the SAP/QAPP? (Y/N)							
Test condition within acceptable Limits? (Y/N)							
Control survival (Y/N)							
Reference Toxicant Response within 2 standard deviations of long-term mean? (Y/N)							
Temperature (Y/N)							
Dissolved Oxygen (Y/N)							
pH (Y/N)							
Salinity (Y/N)							
Acclimation Procedures (Y/N)							
Sediment Holding Time <8 weeks (Y/N)							
Statistical Analyses Appropriate (Y/N)							
Ammonia Management (Y/N)							
Overall test data valid? (Y/N)							

15.0 ELEMENT B6 – INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

15.1 Field Instruments

All field instruments are maintained in accordance with manufacturers' recommendations, including but not limited to cleaning, inspection, changing batteries and dissolved oxygen membranes.

Each instrument is inspected, tested, and calibrated prior to mobilizing to the field to ensure all are in good working order. Table 15-1 shows a list of field equipment with their instruction manuals.

Table 15-1. List of Field Instruments and Their Instruction Manuals

Instrument	Instruction Manual
Turbidimeter	Hach 2100P Turbidimeter Manual
Hydrolab Meter and Probe	Hydrolab Instruction Manual Hydrolab Sonde Instruction Manual
Stainless Steel and Teflon® Water Pump	Water Pump Instructions

These documents will be available to the field crew as hard copy or electronic files at all times the equipment is in use. Instrument calibration documentation will be stored in the project files. ANAMAR's equipment requires limited maintenance. Repairs will be documented and the records stored at ANAMAR's headquarters. In situ readings are recorded on the sediment field sheets.

15.2 Laboratory Instruments

The QAM and/or SOPs for each laboratory list the analytical equipment used for testing, along with relevant calibration and SRM used, maintenance schedules, and recordkeeping methods. The accuracy and precision limits included in the QAM and SOPs of the analytical laboratory meet the criteria established for this evaluation. The laboratory managers/directors listed in Section 4.3 will be responsible for assigning appropriately trained analysts to perform the specific tests. As part of the NELAC certification, corrective procedures have also been established if QA objectives are not met.

16.0 ELEMENT B7 – INSTRUMENT CALIBRATION AND FREQUENCY

16.1 Field Instruments

Prior to field mobilization, all instruments used to take readings in the field will be calibrated according to the manufacturers' recommended procedures. A calibration verification of the instruments will be performed at the beginning of each sampling day. An end-of-day reading will be taken to document that the instrument remained calibrated throughout the sampling day. This calibration will be recorded and documented on a calibration log and supplied to USACE with copies of all field paperwork. Acceptance limits for in situ measurements are:

- pH: ±0.2 SU
- Conductivity: ±5%
- Dissolved Oxygen: ±0.3 mg/L from target dissolved oxygen reading
- Turbidity: 0.1-10 NTU ±10%; 11-40 NTU ±8%; 41-100 NTU ±6.5%; >100 NTU ±5%

In situ measurements are recorded directly from field equipment and cannot be made from samples stored for any length of time. ANAMAR will have available a second instrument of the same or similar type with identical capabilities to ensure that all measurements can be recorded. If any calibration verification exceeds the limits shown above, the verification will be performed a second time to determine if the instrument is out of control. If the verification for both readings is still outside control limits, the backup meter will be used. If both meters fail to achieve any of the acceptance criteria listed above, the data will be qualified in the final report to the client. The affected results will be clearly identified in the data table and the nature of the problem will be explained in the text of the report. Its impact on any other physical, chemical, or toxicological results will be assessed.

16.2 Laboratory Instruments

All laboratory instruments used in the analysis of sediment, site water, elutriate, tissue, and toxicological parameters will be calibrated according to the method, laboratory QAM, SOPs, or any other NELAC-approved method. All calibration records will be documented and provided in the laboratory reports according to the above procedures. Any failure of the laboratory to achieve acceptable calibration will necessitate corrective action by the laboratory in accordance with their quality manual and SOPs.

17.0 ELEMENT B8 – INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Sediment and water samples will be stored in Teflon® bags that have been pre-cleaned using the procedures shown in Section 11.1.9. For containers provided by the laboratory(s) for site water analysis, Certificates of Analysis will be kept by the laboratory according to their QAM and/or SOPs.

All calibration standards for field instruments will be used before their expiration date. Lot numbers and expiration dates of each standard used will be recorded on the calibration sheets. Standards will also be appropriate for the results expected in the field (i.e., if marine water is being measured, conductivity standards will accurately represent marine water as opposed to fresh water).

All laboratory consumables will be inspected, handled, stored, documented, and used according to NELAC requirements and in accordance with each laboratory's QAM and/or SOPs.

18.0 ELEMENT B9 – DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

Various forms of data (photographs, maps, GIS data, analytical data, etc.) will be generated while implementing this project. All data generated during this project will be retained by the contractor. Any data not required to be submitted as described in Section 6 will be supplied to USACE or EPA upon request.

19.0 ELEMENT B10 – DATA MANAGEMENT, INTERPRETATION, AND REDUCTION

19.1 Data Management

Both ALS and EcoAnalysts have established NELAC-approved procedures for data management, collection, validation, reduction, and reporting. As such, the analytical results will be extensively reviewed in-house by the laboratories submitting the data.

Each laboratory will submit an electronic data deliverable (where applicable) and a hard copy data packet to ANAMAR. All data tables generated will be cross-checked against the hard copy data packet. When a data packet is received by ANAMAR, it will be reviewed by ANAMAR's QA/QC officer, with emphasis on NELAC standards and data quality objectives described in this QAPP. All laboratory reports received will include laboratory QC data generated during analysis of the project samples, including results of all method blanks, lab duplicates/triplicates, matrix spikes, spike duplicates/triplicates, reference material, surrogate spikes, standards, check standards, and calibration verifications. The analytical results for these QC samples will be reviewed and documented in a CQAR for each analytical data packet received. This report will be incorporated into the final data report. The CQAR consists of a checklist and a case narrative of the analytical runs. Any nonconformance, QC deficiency, or other problem that would impact data quality will be addressed in the CQAR. In particular, the contractor will compare data to the data quality objectives listed in Section 14, as well as confirm that target detection limits listed in Section 13.3.1 were achieved. If any data quality objective is not achieved, the laboratory will re-analyze the sample(s) and/or provide documentation for the failed criteria. The CQAR will contain a written record of the validity of each data package and its subsequent use in the report.

Field parameters, sample descriptions, site conditions, and additional information pertaining to the sample and sampling process will be recorded on site-specific field sheets. Calibration data for field instruments will be recorded on calibration sheets. A DQCR will be filled out for each day of sampling and sample processing. Each of these records is integral to the successful completion of this project. As such, they will be reviewed, reported, and retained as described elsewhere in this document.

19.2 Data Interpretation and Reduction

Data reduction in the final report will be performed as discussed in the Green Book and the SERIM. Sediment data will be used to determine the appropriate tissue chemistry contaminants. As stated in the SERIM, if a contaminant is found in a sediment sample at a detectable level above the LRL, the contaminant should also be tested in the corresponding tissue samples. Results that appear to be anomalous will be addressed with the laboratory and brought to the attention of the client and regulatory agencies to determine if additional corrective actions are required.

Elutriate data will be compared to the CMC. Contaminants that exceed their corresponding CMC may require STFATE modeling, as addressed below.

Tissue data will compare project tissue samples against both the FDA action limits (Appendix H in the SERIM) and the reference samples. If the average for a contaminant in the project tissues exceeds the average for the reference tissues, a statistical analysis of the project tissues will be performed to determine statistical significance as stated in the SERIM. Results that are

statistically greater than either the FDA action limits or the reference tissue will be identified in the draft and final sediment testing reports.

The STFATE model will be used and run only for the COC that requires the greatest dilution for Tier II evaluations, and shall also be performed on any sample in which the laboratory reporting limit exceeds the water quality criteria. A Tier III evaluation will be performed on all samples for which the water column tests are statistically greater than the LC_{50} or EC_{50} of the control water or dilution water. Numerical input parameters to be used for the STFATE will be taken from the latest approved Site Management and Monitoring Plan. The parameters used for this project will be confirmed with USACE and EPA after elutriate chemistry and toxicological results have been received, and the samples requiring models have been determined. The input parameters for modeling are shown below in Tables 19-1 and 19-2.

Table 19-1. Input Parameters for STFATE Modeling

Parameter	Keyword	Value
Model Coefficients		
Settling Coefficient	BETA	0.000*
Apparent Mass Coefficient	CM	1.000*
Drag Coefficient	CD	0.500*
Form Drag for Collapsing Cloud	CDRAG	1.000*
Skin Friction for Collapsing Cloud	CFRIC	0.010*
Drag for an Ellipsoidal Wedge	CD3	0.100*
Drag for a Plate	CD4	1.000*
Friction Between Cloud and Bottom	FRICTN	0.010*
4/3 Law Horizontal Diffusion Dissipation Factor	ALAMDA	0.001*
Unstratified Water Vertical Diffusion Coefficient	AKYO	Pritchard Expression
Cloud/Ambient Density Gradient Ratio	GAMA	0.250*
Turbulent Thermal Entrainment	ALPHAO	0.235*
Entrainment in Collapse	ALPHAC	0.100*
Stripping Factor	CSTRIP	0.003*
Parameter	**Value**	**Units**
Site Description		
Number of Grid Points (left to right)	45	n/a
Number of Grid Points (top to bottom)	45	n/a
Spacing Between Grid Points (left to right)	700	ft
Spacing Between Grid Points (top to bottom)	700	ft
Constant Water Depth	45	ft
Parameter	**Value**	**Units**
Roughness Height at Bottom of Disposal Site	0.005*	ft
Slope of Bottom in X-Direction	0	degrees
Slope of Bottom in Z-Direction	0	degrees
Number of Points in Ambient Density Profile Point	3	n/a
Ambient Density at Depth = 0 ft	1.0241	g/cc
Ambient Density at Depth = 22.5 ft	1.0241	g/cc
Ambient Density at Depth = 45 ft	1.0248	g/cc
Disposal Point Distance from Top Edge of Grid	15,750	ft

Table 19-1. Input Parameters for STFATE Modeling

Disposal Point Distance from Left Edge of Grid	7,875	ft
Location of Upper Left Corner of Disposal Site (distance from top edge of grid)	555	ft
Location of Upper Left Corner of Disposal Site (distance from left edge of grid)	10,393.5	ft
Location of Lower Right Corner of Disposal Site (distance from top edge of grid)	30,945	ft
Location of Lower Right Corner of Disposal Site (distance from left edge of grid)	21,106.5	ft
Current Velocity Data		
Water Depth	45	ft
Profile	Logarithmic	
X-Direction Velocity	0	ft/sec
Z-Direction Velocity	0.65	ft/sec
Material Data		
Dredging Site Water Density	calculated from in situ data collected at the site water location	g/cc
Number of Layers	1	–
Material Velocity at Disposal (X-direction)	6.2	ft/sec
Material Velocity at Disposal (Z-direction)	6.2	ft/sec
Model Run Times and Intervals		
Duration of Simulation	14,400	sec
Long-Term Time Step	600	sec

* Model default value

In addition to the input parameters provided in the SMMP, specific inputs for the dredge to modeled are included in Table 19-2. While the specific dredge to be used has not been identified, the parameters in the table represent the largest capacity available by type, and are being used in the model to provide the greatest flexibility for the USACE when dredging the material.

Table 19-2. Dredge Operation Data

Parameter	Value, Cutter/Hopper	Value, Mechanical	Units
Length of Disposal Vessel	390	315	ft
Width of Disposal Vessel	76	53	ft
Pre-Disposal Draft	28	25	ft
Post-Disposal Draft	15	10	ft
Time Needed to Empty the Disposal Bin (sec)	60	60	sec
Material Volume for Sample	13,500	9,000	cy
Maximum Volume to be Modeled (To allow for larger dredging vessels that may be used in the future)	20,000	15,000	cy

Results of the water column toxicity tests are used to calculate an LC_{50} and/or an EC_{50}. The water column limiting permissible concentration (LPC) for the dredge material is 1% of the LC_{50}. If the numerical mixing model predicts that the concentration of dredged material in the water column will not exceed 1% of the LC_{50} concentration, either outside the disposal site or within the disposal

site, 4 hours after the discharge of dredged material, the proposed discharge of dredged material meets the water column LPC. If either criterion is not met, the dredge material does not meet the water column LPC, and the model will be re-evaluated using alternative options, e.g. using lower volumes of sediment for disposal or relocating the disposal site to a more favorable area in the ODMDS.

Toxicity and bioaccumulation data will undergo statistical analysis in accordance with the Green Book and Appendix D of the ITM. The goal is to determine whether the mean effect of exposure to dredged sediment is significantly greater than the mean exposure to the reference sediment. All reports will undergo extensive internal review and will be submitted to USACE-Wilmington. Accompanying the final report will be a CD containing all of the project files, including electronic versions of all data reports, maps, figures, tables, text, photos, and any other electronic files used to generate the project report.

A final evaluation report will be submitted that will summarize the results in the sediment testing report and address any exceedances as stated above, including a risk-based evaluation.

All reports will undergo extensive internal review before submission to USACE and EPA. Accompanying the final report will be a CD containing all the project files, including electronic versions of all data reports, maps, figures, tables, text, photos, and any other electronic files used to generate the report.

GROUP C. ASSESSMENT AND OVERSIGHT

20.0 ELEMENT C1 – ASSESSMENTS AND RESPONSE ACTIONS

The prime contractor and its subcontractors are periodically assessed on their performance and standard procedures that are in place for all aspects of sampling and analysis. Assessments and response actions throughout the life of this project are the responsibility of the contractor QA/QC Officer and are performed in-part through the review and audit process.

Performance and systems audits are performed to evaluate the capability and performance of a measurement system. Audits are utilized to ensure that field and laboratory activities will provide data reflective of site conditions and within project QA/QC requirements. A performance audit is used to evaluate the accuracy of a measurement method or component of the method. A systems audit focuses on evaluating the principal components of a sample collection or data collection method to determine proper selection and use of that method.

20.1 Field Assessments

All field activities are overseen by the project manager or other supervisor familiar with all sampling procedures and project goals. All measurements and observations collected during sampling will be documented using the forms shown in Table 12-1 and in Attachment 3. After sampling has been completed, the data will be summarized in tables, reviewed by someone other than the field sampler, and presented as part of the sediment testing report.

In addition, field audits have been conducted on past projects on both informal and formal bases by regulatory personnel. ANAMAR's most recent field audit was performed by EPA in December 2014. During these audits, the auditor examined sampling procedures and documentation including field sheets, SOPs, equipment, and sample handling. Recommendations made during audits should be incorporated into field sampling programs and SOPs.

20.2 Laboratory Assessments

All laboratories performing work for this project are subject to regular assessments as part of their normal QC practices. Each laboratory has a QA program with written SOPs for all their activities, including sample preparation and analysis and internal data review. All laboratory data are reviewed by qualified personnel (QA officer, project manager, or equivalent), with emphasis on laboratory QC indicators and project guidelines.

Additionally, NELAC-accredited laboratories undergo routine performance and system audits by outside agencies. Assessments and response actions throughout the life of this project are the responsibility of the contractors QA/QC Officer and are performed in-part through the review and audit process.

Performance audits consist primarily of samples obtained from an accredited supplier. For NELAC accreditation, laboratories must pass a minimum of two out of three samples analyzed at least every 6 months for each analyte tested. Failure to meet this requirement will cause the laboratory to lose accreditation.

System audits are performed by an independent state or private auditor at least once every 2 years. These audits will examine all aspects of the laboratory operation, from sample log-in through report preparation, to ensure that the laboratory meets all requirements of the NELAC

program. Any deficiencies noted by the auditor must be addressed by laboratory management to maintain accreditation.

21.0 ELEMENT C2 – REPORTS TO MANAGEMENT

Each laboratory shall include periodic reports to management as part of its QA program. These reports will include internal audits with corrective actions; findings with corrective actions of any external audits, either by regulatory agencies or clients; results of proficiency testing samples; and any routine issues directly related to quality assurance or control within the laboratory that have been found since the most recent audit. These reports should be maintained at the laboratory for a minimum of 5 years.

Any report that may have a direct impact on the samples included in this project should be addressed with ANAMAR's project manager or QA officer to determine the appropriate corrective action. All correspondence that may have an impact on the overall quality of the results will be included in the final report to the client.

Once received from the laboratories, the results will be incorporated into text, tables, and charts to more readily allow for evaluation by USACE and EPA.

GROUP D. DATA VALIDATION AND USABILITY

22.0 ELEMENT D1 – DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data validation is a process used to accept or reject data and determine if the data are traceable, defensible, and can be used for a particular project. Each laboratory has established procedures for data collection, validation, reduction, and reporting. As such, the analytical results will be extensively reviewed in-house by the laboratories submitting the data.

All physical and chemical results will be compared to the reporting limits in Tables 13-2 through 13-5. All toxicological results will be compared to the acceptance criteria in Tables 13-6 through 13-9. All QC results for physical, chemical, and toxicological analyses will be compared to the tables in Section 14.0.

ANAMAR's QA officer will review all laboratory results in accordance with the procedures described above. Any data that do not meet the acceptance criteria in the data tables will be qualified in bold italics with a shaded background. EPA Region 4 and USACE will have the final authority to determine the acceptability of the project data.

23.0 ELEMENT D2 – VALIDATION AND VERIFICATIONS METHODS

23.1 Field Data Validation

In situ readings and calibration of field equipment used to take the readings will be validated by ANAMAR's QA/QC officer using the criteria in Section 16.0 (meter reading compared to calibration standard). All field results will be reviewed with an emphasis on NELAC standards, where applicable, and conformance to the data quality objectives set forth in this QAPP.

Instrument calibration will be verified prior to each sampling day. An end-of-day reading will be taken at the completion of sampling each day. Any reading outside the acceptance criteria will be flagged as described in Section 16.0, and the overall impact to the data quality and usability will be assessed. Field sheets will be reviewed for completeness, as well as any site conditions that may have an impact on the final results. Calibration sheets will document the pre-calibration, post-calibration, and end-of-day readings.

23.2 Laboratory Data Validation

When a physical, chemical, or toxicological data packet is received, it is reviewed by ANAMAR's QA/QC officer, with emphasis on NELAC standards and conformance to the data quality objectives set forth in this QAPP. Chemistry data reports include laboratory QC data generated during analysis of the project samples, including results for all method blanks, lab duplicates/triplicates, matrix spikes, spike duplicates/triplicates, reference material, surrogate spikes, standards, check standards, and calibration verifications. All physical testing reports will include sample duplicates/triplicates. All toxicology reports will include all setup conditions; daily measurements of parameters such as salinity, dissolved oxygen and pH; and statistical evaluations of the survival and development rates. The analytical results for these QC samples will be reviewed and documented in a CQAR for each analytical data packet received. This report will be incorporated into the final data report. The CQAR consists of a checklist and a case narrative of the analytical runs. Any nonconformance, QC deficiency, or other problem that would impact data quality will be addressed in the CQAR. ANAMAR will compare data to the data quality objectives listed in Section 14.0 and will confirm that target detection limits listed in Section 13.3 were reached. If any data quality objective is not reached, the laboratory will re-analyze the sample(s) and/or provide documentation for the failed criteria. The CQAR will provide a written record of the validity of each data package and its subsequent use in the report. After all data have been reviewed and validated, an assessment of the impact on the data quality and usability of the results will be made and included in the report to the client.

24.0 ELEMENT D3 – RECONCILIATION WITH DATA QUALITY OBJECTIVES

By comparison with the laboratory results, ANAMAR's QA officer will reconcile all chemical, physical, and toxicological data with the data quality objectives listed in Section 14.0 and with the target detection limits shown in Section 13.3. Analytical data that fall outside the acceptable QC limits will be addressed in a case narrative, and any corrective action taken will be described in detail. QC failures that are not adequately addressed will be re-prepared or re-analyzed at the laboratory's expense. All analytical anomalies will be described in detail in the final report. In the case of reruns, the initial and rerun result will be presented in the final report.

Many analytical methods describe procedures for analytical anomalies that occur during analysis. These method-specific procedures must be followed.

Tissue chemistry following the bioaccumulation potential tests will be run on each of the five replicates of each sample and species. The five individual results will be averaged and compared to the average of the reference samples for each analyte. Results greater than 100% of the reference sample will undergo statistical analysis according to procedures described in the Green Book and/or the SERIM.

25.0 REFERENCES

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